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# ON THE RECENT OCCURRENCE OF ELASMOBRANCH SPECIES IN TUNIS SOUTHERN LAGOON (NORTHERN TUNISIA, CENTRAL MEDITERRANEAN)

*Hamadi MEJRI, Jamila BEN SOUISSI & Jeanne ZAOUALI*
Département des Ressources Animales, Halieutiques et des Technologies Agro-alimentaires, Institut National Agronomique de Tunisie, 43 avenue Charles Nicolle, 1082 Tunis, Tunisie

*Amor El ABED*
Institut des Sciences et Technologies de la Mer, 2025 Salammbô, Tunisie

*Yvan VERGNE, Olivier GUÉLORGET & Christian CAPAPÉ*
Laboratoire d'Ichtyologie, case 104, Université Montpellier II, Sciences et Techniques du Languedoc,
F-34 095 Montpellier cedex 05, France
E-mail: capape@univ-montp2.fr

## *ABSTRACT*

*During the investigations conducted after an environmental restoration of the Tunis Southern Lagoon, close to the Gulf of Tunis (northern Tunisia), seven elasmobranch species were collected for the first time in the area:* Rhinobatos cemiculus, R. rhinobatos, Torpedo marmorata, T. torpedo, Raja radula, Dasyatis pastinaca *and* Pteromylaeus bovinus. *Three species*, R. rhinobatos, T. torpedo *and* P. bovinus, *seem to live permanently in the area. The seven species are described and their uncommon occurrence commented.*

**Key words**: elasmobranchs, environmental restoration, Tunis Southern Lagoon, Tunisia, Mediterranean

# RECENTE SEGNALAZIONE DI VARIE SPECIE DI RAZZE NELLA LAGUNA MERIDIONALE DI TUNISI (TUNISIA SETTENTRIONALE, MEDITERRANEO CENTRALE)

*SINTESI*

*Nel corso di ricerche condotte dopo un intervento di rinnovo ambientale nella laguna meridionale ai margini del Golfo di Tunisi (Tunisia settentrionale), sono state segnalate sette specie di Elasmobranchii:* Rhinobatos cemiculus, R. rhinobatos, Torpedo marmorata, T. torpedo, Raja radula, Dasyatis pastinaca *e* Pteromylaeus bovinus. *Sembra che le specie* R. rhinobatos, T. torpedo *e* P. bovinus *siano divenute stanziali. Gli autori descrivono tutte e sette le specie ed esaminano le ragioni che hanno portato alla loro presenza nella zona.*

**Parole chiave:** Elasmobranchii, rinnovo ambientale, laguna meridionale di Tunisi, Tunisia, Mediterraneo

## INTRODUCTION

Records of elasmobranch species are rarely reported from perimediterranean lagoons and generally considered to be occasional, probably due to fortuitous events (Paris & Quignard, 1971; Quignard & Zaouali, 1980, 1981; Rhomdane, 1985).

However, in the Bahiret El Biban, a hyperhaline lagoon located in southern Tunisia, adjoining the Gulf of Gabès, Capapé *et al. (in press)* noted five species, at least, developing and reproducing in the area. By contrast, Zaouali (1977) reported a non-occurrence of elasmobranch species in both Tunis Northern and Southern Lagoons, adjoining the Gulf of Tunis, in northern Tunisia (Fig. 1). Both areas have been recently subjected to environmental restoration and, soon after, investigations were conducted in order to assess its effects on both areas (Ben Charrada, 1992; Ben Maiz, 1997; Vandenbroek & Ben Charrada, 2001; Ben Souissi, 2002; Ben Souissi *et al.*, 2003).

During the investigations focusing on ichthyological fauna from the Tunis Southern Lagoon, 65 species were identified, 51 of which were recorded for the first time in the area, including seven elasmobranch species (Ben Souissi *et al., in press)*. These species are presented and described in the present article and their occurrence commented in greater detail.

## MATERIAL AND METHODS

Formerly, the Tunis Southern Lagoon covered 1,120 ha, with depths ranging from 0.15 to 1.1 m; the average depth was about 0.6 m. As a consequence of an ecological restoration, the surface has been considerably reduced, now covering 720 ha, with a regular depth of about 2.10 m throughout the lagoon, except in restricted areas where it reaches 4 m at the most (Ben Souissi *et al., in press*). It appears as an elongated ellipse directed SW-NE: 36°17′53.4″ and 36°47′48.0″ N, and 10°12′22.2″ and 10°16′41.4″ E. Its northern border is the navigation channel, which is 10 km long and max. 12 m deep (Fig. 2).

Before the lagoon's ecological rehabilitation, the average monthly salinity ranged between 30.9 and 48.9 psu, with a peak of 51.9 psu that occurred in 1995; after rehabilitation it ranged between 37 and 38.3 psu and the monthly average was 37.8 psu (Ben Souissi *et al.*, 2003).

By contrast, both monthly and annual temperature values did not show significant differences before and after the rehabilitation (Ben Souissi *et al.*, 2003).

Our investigations were regularly conducted between 2001 and 2004, three times at least per week. Elasmobranch species were collected soon after they were landed. They were mainly caught by gill-nets and trammel nets, occasionally by cast-nests, landing-nets, anglers and diving. Fresh and sometimes alive specimens were examined.

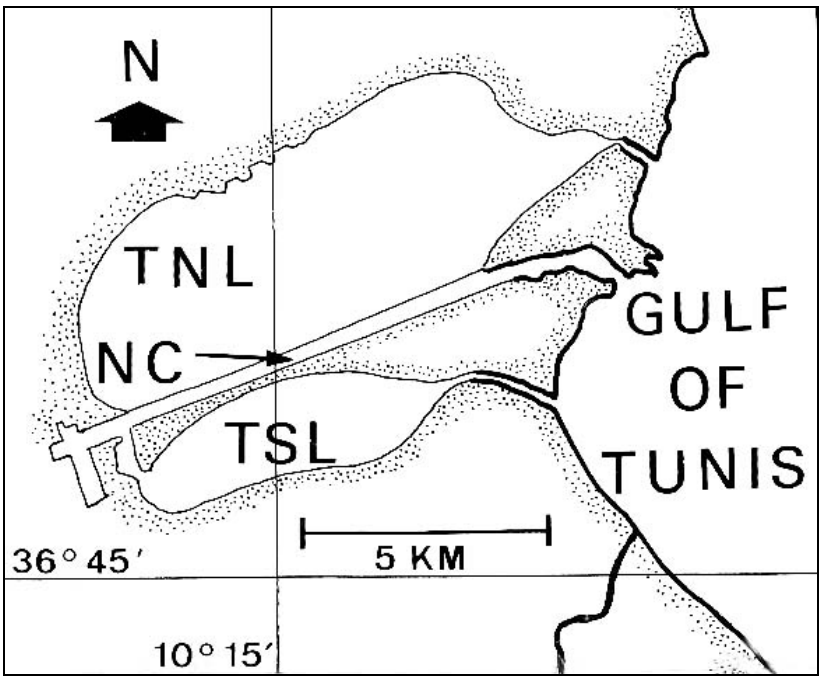


***Fig. 1: Map of Tunis Lagoon showing both Tunis Northern Lagoon (TNL) and Tunis Southern Lagoon (TSL), and navigation channel (NC) after the environmental restoration.***
***Sl. 1: Zemljevid Tuniške lagune s severno (TNL) in južno laguno (TSL) in navigacijskim kanalom (NC) po okoljski prenovi.***

Methods of measurements and counts are given following Tortonese (1956), Bini (1967), Hulley (1970, 1972), Capapé & Quignard (1975), Capapé *et al.* (1981), Cowley & Compagno (1993). For males, the clasper length was measured following Collenot (1969). For rhinobatids and torpedinids, total length (TOT) and for skates and rays, disk-width (DW) were used for percentage references.

All the specimens described below are preserved, each with its catalogue number, in 5% buffered formaline in the Ichthyological Collection of the Institut National Agronomique de Tunis (INAT).

## RESULTS

Seven species belonging to five families were recorded in the Tunis Southern Lagoon.

### Family Rhinobatidae

**Blackchin guitarfish *Rhinobatos cemiculus* (E. Geoffroy Saint-Hilaire, 1817)**

The specimen under Cat. No. RHI-Rhc-02 (Fig. 3) was captured on 28 October 2004 by gill-net in the mid-part of the lagoon, at a depth of ca. two metres, on sandy-muddy-detritic bottom partially covered with macroalgae such as *Cladophora vagabunda* (Linnaeus, 1758). It was 823 mm TOT and weighed 1701 g.

Disk sub-triangular with snout elongated, acute at distal end and tip strongly rounded, anterior margin slightly convex at level of eyes, posterior and inner margins rounded. Rostral ridges narrowly separated, slightly converging at midline. Pelvic fins quite separate from pectoral fins, sub-triangular and acute at distal end. First dorsal fin largely behind tip of pelvic fins. Anterior nasal lobes not reaching to level of inner corner of nostril. Tail large and broad distinctly marked off the disk broadly depressed dorso-ventrally, with well-developed lateral folds.

Disk-width 32.9%, disk-length 40.7%, pre-oral length 17.1%, pelvic span 22.5%, pelvic fin anterior margin 8.3%, caudal fold length 35.7% all in total length. Pre-orbital length 3.8 times, width between the first pair of gill-slits 3.3 times and distance between the fifth pair of gill-slits 2.4 times in interorbital width. Eyeball length 50%, spiracle length 46.0% in interorbital width. Snout angle 55°. Mouth slightly arched 2.4 times in pre-oral length. Tail length 54.9% in total length, 1.4 times in disk-length and 1.7 times in disk-width.

Dorsal and ventral surfaces entirely smooth. Thorns present around inner margin of orbits, between spiracles and shoulders and along midline of disk and tail. Total tooth rows 94/105 in upper/lower jaws.

Dorsal surface brownish with transversal darker strips on tail, rather beige on outer margin of disk and fins. Ventral surface white with black notch on snout.

Measurements, counts, description and colour are summarized in Table 1 and are in agreement with Norman (1926), Tortonese (1956), Bini (1967), Capapé *et al.* (1981), Fischer *et al.* (1987).

Aspects of the reproductive biology and diet of the blackchin guitarfish from specimens caught in the Gulf of Gabès and the Bahiret El Biban, were studied by Capapé & Zaouali (1979, 1994). Sizes at first sexual maturity of males and of females are 1000 mm and 1100 mm TOT, respectively. Adult females are generally larger than males, maximal TOT for males and females are 1920 mm and 2300 mm respectively. So, the described specimen is juvenile. In the area, the specimen was included among the first species that entered the lagoon; however, at present, its capture remains very rare. Three specimens were collected, with 639 mm, 823 mm and 919 mm TOT, and weighing 877 g, 1701 g and 2297 g.

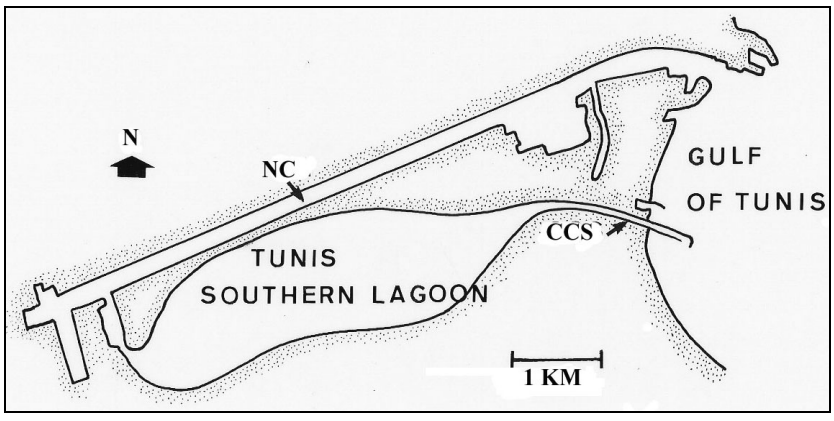


***Fig. 2: Tunis Southern Lagoon, showing navigation channel (NC) and the channel of communication with sea (CCS).***
***Sl. 2: Tuniška južna laguna z navigacijskim kanalom (NC) in kanalom, ki laguno povezuje z morjem (CCS).***

***Tab. 1: Total mass (in g) and measurements (in mm and as % TOT) of** R. cemiculus **and** R. rhinobatos **from Tunis Southern Lagoon.***
***Tab. 1: Celotna masa (v g) in dimenzije (v mm in % TOT) pri vrstah** R. cemiculus **in** R. rhinobatos **iz Tuniške južne lagune.***

| **Species** | ***Rhinobatos cemiculus*** | | ***Rhinobatos rhinobatos*** | |
|---|---|---|---|---|
| Cat. No. | RHI-Rc-02 | | RHI-Rrh-01 | |
| **Total mass (g)** | 1701 | | 2058 | |
| **Measurements** | mm | % TOT | mm | % TOT |
| Total length (TOT) | 823 | 100.0 | 854 | 100.0 |
| Disc length | 335 | 40.7 | 330 | 38.6 |
| Disc width | 271 | 32.9 | 284 | 33.2 |
| Disc depth | 48 | 5.8 | 45 | 5.2 |
| Eyeball length | 17 | 2.1 | 27 | 3.2 |
| Cornea | 10.0 | 1.2 | 17 | 2.9 |
| Pre-orbital length | 133 | 16.2 | 104 | 12.1 |
| Inter-orbital width | 35 | 4.2 | 31 | 3.6 |
| Spiracle length | 16 | 1.9 | 22 | 2.6 |
| Spiracle width | 12 | 1.5 | 11 | 1.3 |
| Inter-nasal width | 67 | 8.1 | 55 | 6.4 |
| Nasal curtain | 27 | 3.3 | 22 | 2.6 |
| Inter-spiracular width | 42 | 5.1 | 42 | 4.9 |
| Pre-oral length | 141 | 17.1 | 114 | 13.3 |
| Mouth width | 60 | 7.3 | 65 | 7.6 |
| First gill slit | 12 | 1.5 | 13 | 15.2 |
| Second gill slit | 14 | 1.7 | 13 | 15.2 |
| Third gill slit | 12 | 1.5 | 13 | 15.2 |
| Fourth gill slit | 12 | 1.5 | 13 | 15.2 |
| Fifth gill slit | 10 | 1.2 | 9 | 1.1 |
| Width between first gill slit | 111 | 13.5 | 108 | 12.6 |
| Width between fifth gill slit | 79 | 9.6 | 79 | 9.2 |
| Snout tip to eye | 138 | 16.8 | 110 | 13.0 |
| Snout tip to mouth | 153 | 18.6 | 128 | 15.0 |
| Snout tip to first gill slit | 196 | 23.9 | 175 | 20.4 |
| Snout tip to fifth gill slit | 229 | 27.8 | 207 | 24.2 |
| Snout tip to pelvic fin | 315 | 38.3 | 320 | 37.4 |
| Snout tip to vent | 345 | 41.9 | 336 | 39.4 |
| Pectoral fin anterior margin | 271 | 32.9 | 260 | 30.4 |
| Pectoral fin posterior margin | 118 | 14.3 | 126 | 14.8 |
| Pectoral fin inner margin | 20 | 2.4 | 23 | 2.7 |
| Pelvic fin anterior margin | 68 | 9.8 | 73 | 8.5 |
| Pelvic fin posterior margin | 66 | 9.2 | 81 | 9.5 |
| Pelvic fin inner margin | 46 | 6.6 | 45 | 5.3 |
| Span of pelvic fins | 186 | 21.3 | 18 | 2.1 |
| Tail base width | 86 | 10.4 | 90 | 10.5 |
| Tail base depth | 40 | 4.8 | 38 | 4.5 |
| Tail length | 452 | 54.9 | 480 | 56.2 |
| Snout tip to first dorsal | 482 | 58.6 | 490 | 57.3 |
| Snout tip to second dorsal | 593 | 72.1 | 625 | 73.1 |
| Snout tip to caudal dorsal birth | 680 | 82.6 | 723 | 84.6 |
| Snout tip to caudal ventral birth | 700 | 85.1 | 751 | 87.9 |
| Caudal superior | 83 | 13.0 | 133 | 15.5 |
| Pelvic fins base to first dorsal origin | 85 | 10.3 | 105 | 12.3 |
| Caudal superior edge | 143 | 17.4 | 133 | 15.6 |
| Caudal inferior edge | 53 | 6.4 | 62 | 7.3 |
| Caudal posterior edge | 85 | 10.3 | 68 | 8.0 |
| First dorsal anterior edge | 85 | 10.3 | 89 | 10.4 |
| First dorsal posterior edge | 56 | 6.8 | 68 | 8.0 |
| First dorsal inner edge | 24 | 2.9 | 20 | 2.3 |
| First dorsal base | 38 | 4.7 | 43 | 5.0 |
| Second dorsal anterior edge | 85 | 10.3 | 85 | 9.9 |
| Second dorsal posterior edge | 58 | 7.0 | 62 | 10.8 |
| Second dorsal inner edge | 20 | 2.4 | 18 | 2.1 |
| Second dorsal base | 41 | 5.0 | 45 | 5.3 |
| Inter-dorsal distance | 75 | 9.1 | 99 | 11.6 |
| Second dorsal to caudal birth | 46 | 5.6 | 57 | 66.7 |
| Caudal careen length | 294 | 35.7 | 301 | 35.2 |

**Common guitarfish *Rhinobatos rhinobatos* (Linnaeus, 1758)**

The specimen with Cat. No. RHI-Rhr-01 (Fig. 4) was captured on 17 September 2003, by trammel net, close to the channel of communication with sea, and it weighed 2058 g.

General morphology similar to *R. cemiculus* but snout shorter and strongly rounded. Rostral ridges widely separated throughout length and converging little in front. Anterior nasal lobes reaching to inner corner of nostril.

Disk-width 33.2%, disk-length 38.6%, pre-oral length 13.3%, pelvic span 21.0%, pelvic fin anterior margin 8.5%, caudal fold length 35.2% all in total length. Pre-orbital length 3.4 times, width between the first pair of gill-slits 3.5 times and distance between the fifth pair of gill-slits 2.5 times the inter-orbital width. Eyeball length 87.1%, spiracle length 70.9% in inter-orbital width. Snout angle 85°. Mouth slightly arched 1.75 times in pre-oral length. Tail length 56.2% in total length, disk-length 1.45 times and disk-width 1.8 times all in tail length.

Dorsal and ventral surface entirely smooth. Thorns present around inner margin of orbits, between spiracles and along midline of disk and tail. Total tooth rows 105/112 in upper/lower jaws.

Dorsal surface beige to brownish with darker notches and transversal bluish strips on tail, rather beige on outer margin of disk and fins. Belly whitish; rather darker on margins of disk and tail.

Measurements, counts, description and colour are summarized in Table 1 and are in agreement with Norman (1926), Tortonese (1956), Bini (1967), Capapé *et al.* (1981), Fischer *et al.* (1987).

Aspects of the reproductive biology of the common guitarfish were studied by Capapé *et al.* (1997) and its diet and feeding habits by Capapé & Zaouali (1979) from specimens caught in the Gulf of Gabès and in the Bahiret El Biban. Size at first sexual maturity were 750 and 850 mm TOT for males and females, respectively, and maximum size for males and females 1400 mm and 1620 mm TOT, respectively. The smallest gravid female observed was 860 mm TOT. Numerous small free living specimens with residual have been found in the lagoon. Their sizes ranged from 290 mm to 400 mm (Capapé *et al.*, *in press)*.

The described specimen is an adult female. Previously considered as rare in the Tunis Southern Lagoon, *Rhinobatos rhinobatos* has become rather common in the area since the summer 2004. Fifteen specimens were captured during this period on sandy-muddy bottoms, where benthic invertebrates such as molluscs and decapod crustaceans were especially abundant. Their TOT ranged between 624 and 854 mm (mean: 714 ± 63.9 mm) and their mass between 711 and 2058 g (mean: 1188.8 ± 3006.6 g). The relationship total mass (TM) *vs.* total length (TOT) is: TM (g) = 4.44 TOT (mm) - 2002.31; n = 15; r = 0.93.

**Family Torpedinidae**

**Marbled electric ray *Torpedo marmorata* Risso, 1810**

The specimen with Cat. No. TOR-Tom-01 (Fig. 5) was captured on 25 February 2004, by trammel-net. It was 192 mm TOT and weighed 155 g.

Disk rather rounded and subcircular, enlarged pectoral confluent with sides of head. Snout short, subtruncate. Pelvic fins quite separate from pectoral fins, subtriangular and acute at distal end. Tail distinct with two dorsal fins and caudal fin well-developed, this latter with a low keel on each side. Distal end of pelvic fin at level of second dorsal origin. Spiracle with seven tentacles, one tentacle on posterior margin being the largest.

Disk-width 63.0%, disk-length 60.4%, pre-oral length 9.8%, pelvic span 32.3%, pelvic fin anterior margin 10.4%, caudal fold 13% all in total length. Pre-orbital length 3 times width between first pair of gill-slits and width between the fifth pair of gill-slits 3.3 times in interorbital width. Spiracle 2.2 times in eyeball length. Mouth crescentic with longitudinal fold on each side. Tail length 29.2% in total length, 2.1 times in disk-length and 2.16 times in disk-width. Total tooth rows 26/24 in upper/lower jaws.

Dorsal surface brownish with dark notches. Belly beige with margin slightly brownish.

Measurements, counts, description and colour are summarized in Table 2 and are in agreement with Tortonese (1956), Bini (1967), Cadenat *et al.* (1978) and Fischer *et al.* (1987).

Aspects of the reproductive biology and feeding habits of specimens from the Gulf of Tunis were studied by Capapé (1979), who noted that males and females are adult above 290 and 390 mm TOT, respectively. The observed female is juvenile.

The marbled electric ray is occasionally captured in the Tunis Southern Lagoon.

***Tab. 2: Total mass (in g) and measurements (in mm and as % TOT) of** T. marmorata **and** T. torpedo **from Tunis Southern Lagoon.***

***Tab. 2: Celotna masa (v g) in dimenzije (v mm in % TOT) pri vrstah** T. marmorata **in** T. torpedo **iz Tuniške južne lagune.***

| **Species** | ***Torpedo marmorata*** | | ***Torpedo torpedo*** | |
|---|---|---|---|---|
| Cat. No. | TOR-Tom-01 | | TOR-Tot-02 | |
| **Total mass (g)** | 155 | | 94 | |
| **Measurements** | mm | % TOT | mm | % TOT |
| Total length (TOT) | 192 | 100.0 | 178 | 100.0 |
| Disk-length | 116 | 60.4 | 94 | 52.8 |
| Disk-width | 121 | 63.0 | 110 | 61.7 |
| Disk-depth | 18 | 9.4 | 20 | 11.2 |
| Eyeball length | 9 | 4.7 | 10 | 4.5 |
| Cornea | 3 | 1.6 | 4 | 2.2 |
| Pre-orbital length | 15 | 7.8 | 10 | 5.6 |
| Inter-orbital width | 10 | 5.2 | 8 | 4.5 |
| Spiracle diameter | 4 | 2.1 | 4 | 2.2 |
| Nasal curtain | 11 | 6.0 | 9 | 5.4 |
| Inter-nasal width | 20 | 10.4 | 11 | 6.0 |
| Space between eye and spiracle | 6 | 3.1 | 2 | 1.2 |
| Inter-spiracular width | 11 | 5.7 | 8 | 4.5 |
| Pre-oral length | 19 | 9.8 | 18 | 10.1 |
| Mouth width | 16 | 8.3 | 11 | 6.1 |
| First gill slit | 5 | 2.6 | 4 | 2.2 |
| Second gill slit | 5 | 2.6 | 5 | 2.8 |
| Third gill slit | 6 | 3.1 | 5 | 2.8 |
| Fourth gill slit | 6 | 3.1 | 6 | 2.8 |
| Fifth gill slit | 9 | 4.7 | 4 | 2.2 |
| Width between first gill slit | 33 | 17.2 | 26 | 14.6 |
| Width between fifth gill slit | 28 | 15.6 | 23 | 12.9 |
| Snout tip to eye | 17 | 8.8 | 13 | 7.3 |
| Snout tip to mouth | 21 | 10.9 | 17 | 9.5 |
| Snout tip to first gill slit | 47 | 24.7 | 41 | 23.0 |
| Snout tip to fifth gill slit | 66 | 34.3 | 60 | 33.7 |
| Snout tip to pelvic fin | 101 | 52.0 | 82 | 46.1 |
| Snout tip to vent | 114 | 59.4 | 93 | 52.2 |
| Pectoral fin anterior margin | 47 | 24.4 | 57 | 32.0 |
| Pectoral fin posterior margin | 102 | 53.1 | 65 | 36.5 |
| Pectoral fin inner margin | 7 | 3.6 | 13 | 7.3 |
| Pelvic fin anterior margin | 20 | 10.4 | 25 | 14.0 |
| Pelvic fin posterior margin | 30 | 15.6 | 35 | 19.7 |
| Pelvic fin inner margin | 9 | 4.7 | 5 | 2.8 |
| Span of pelvic fins | 62 | 32.3 | 55 | 31.0 |
| Tail base width | 15 | 7.8 | 14 | 7.8 |
| Tail base depth | 10 | 5.2 | 11 | 6.2 |
| Tail length | 56 | 2.9 | 64 | 36.0 |
| Snout tip to first dorsal | 128 | 66.6 | 105 | 59.0 |
| Snout tip to second dorsal | 145 | 75.5 | 127 | 71.3 |
| Snout tip to birth of dorsal caudal | 163 | 84.5 | 147 | 82.6 |
| Snout tip to birth of ventral caudal | 160 | 83.3 | 144 | 81.0 |
| Caudal superior edge | 31 | 16.1 | 26 | 14.6 |
| Caudal inferior edge | 26 | 13.5 | 24 | 13.4 |
| Caudal posterior edge | 30 | 15.6 | 28 | 15.7 |
| First dorsal anterior edge | 22 | 11.5 | 23 | 12.9 |
| First dorsal posterior edge | 14 | 7.3 | 14 | 7.9 |
| First dorsal inner edge | 4 | 2.1 | 5 | 2.8 |
| First dorsal base | 13 | 6.8 | 12 | 6.7 |
| Second dorsal anterior edge | 20 | 10.4 | 17 | 9.6 |
| Second dorsal posterior edge | 10 | 5.2 | 10 | 5.6 |
| Second dorsal inner edge | 3 | 1.6 | 6 | 3.4 |
| Second dorsal base | 10 | 5.2 | 10 | 5.6 |
| Inter-dorsal distance | 6 | 3.2 | 9 | 5.1 |
| Second dorsal to caudal birth | 8 | 4.2 | 10 | 5.6 |
| Caudal careen length | 25 | 13.0 | 30 | 16.9 |

**Common torpedo *Torpedo torpedo* (Linnaeus, 1758)**

Two specimens are preserved in INAT Ichthyological Collection under Cat. Nos. TOR-Tot-01 (Fig. 6) and TOR-Tot-02. They were captured on 23 April 2003 by trammel net. They were 167 and 178 mm TOT and weighed 84 and 94 g. The morphometric measurements of the following description are based on the second specimen only.

General morphology similar to *Torpedo marmorata*, but posterior tip of pelvic fin before second dorsal fin origin. Spiracles with eight short tentacles or knobs.

Disk-width 61.7%, disk-length 52.8%, pre-oral length 10.1%, pelvic span 31.0%, pelvic anterior margin 14.0%, caudal fold 16.9% all in total length. Pre-orbital length 2.6 times width between first pair of gill-slits and width between the fifth pair of gill-slits twice in inter-orbital width. Spiracle 0.8 times in eye-ball length. Tail length 36% in total length, 1.5 times in disk-length, and 1.7 times in disk-width. Total tooth rows 22/20 in upper/lower jaws.

Dorsal surface uniform brownish with whitish notches and five blue-centred ocellae with yellowish margin.

Measurements, counts, description and colour are summarized in Table 2 and are in agreement with Tortonese (1956), Bini (1967), Quignard & Capapé (1974), Capapé & Desoutter (1981) and Fischer *et al.* (1987).

Aspects of the reproductive biology and feeding habits of common torpedoes from the Gulf of Tunis were studied by Quignard & Capapé (1974) who noted that males and females are adult above 190 and 390 mm TOT, respectively. The observed female was juvenile.

The common torpedo is the most abundant and common elasmobranch species encountered in the Tunis Southern Lagoon after its environmental restoration. This recent invader seems to be well adapted to these new abiotic and biotic parameters. Males and females, juveniles and adults are captured all year round throughout the area.

Much of the 16 observed specimens were juvenile. Their TOT ranged from 100 to 255 mm (mean: 160 ± 42.2 mm) and their mass from 84 to 178 g (mean: 78 ± 65.6 g). The relationship total mass (TM) *vs.* total length (TOT) is: TM (g) = 1.47 TOT (mm) - 1553.90; n = 16; r = 0.94.

**Family Rajidae**

**Rough ray *Raja radula* Delaroche, 1809**

Two specimens are preserved in INAT Ichthyological Collection under Cat. Nos. RAJ-Rar-01, (Fig. 7), and RAJ-Rar-02. They were both captured on 22 April 2003 by trammel net. They were 78 and 88 mm DW, respectively, and weighed 14 and 15 g, respectively. The morphometric measurements of the following description are based on both specimens.

Disk sub-quadrangular, obtuse in front, with snout slightly marked and rounded, anterior margin slightly concave at level of eyes and outer corners; outer angles broadly rounded; posterior margins convex. Pelvic fins quite separate from pectoral fins, bilobed with anterior lobe connected with posterior lobe along outer margin of fin. First dorsal larger than second dorsal.

Disk-depth 10.2-10.3%, disk-length 88.5-88.6%, preoral length 20.8-21.2%, pelvic span 44.3-44.9%, pelvic fin anterior margin 19.2-19.3% all in disk-width. Pre-orbital length 2.6-2.7 times, width between first gill slits 2.7-2.8 times, width between fifth gill-slits 1.6 times in interorbital width. Eyeball length 1.6 times in spiracle length and as long as interorbital width. Snout angle 125°. Mouth slightly arched 1.6 times in pre-oral length, nasal curtain fringed as long as mouth. Tail length 103-104% in disk-length, 55.5-55.8% in total-length, 85.2-85.9% in disk-width. Total tooth rows 34/36 in upper/lower jaws for both specimens.

Dorsal surface entirely covered with minute spinules, except on snout. Small separate thorns around eyes, a line of three or four minute thorns on mid-disk, an irregular line of thorns from the origin of tail to first dorsal; two or three thorns between dorsal fins. Ventral surface entirely smooth.

Measurements, counts, description and colour are in agreement with Tortonese (1956), Bini (1967), Capapé (1974), Capapé & Desoutter (1979) and Fischer *et al.* (1987).

The rough ray is often reported from Tunisian waters, where it is commonly caught and landed at fishing sites located along the coast especially in the Gulf of Tunis (Quignard & Capapé, 1971; Capapé, 1974; Bradaï, 2000) and slightly less in the Gulf of Gabès (Ennajar, 2002). Data on the reproductive biology and diet and feeding habits of the specimens from the Gulf of Tunis had been previously provided (Capapé, 1974, 1976a). Males and females from the Gulf of Tunis are adult above 320 and 340 mm disk-width respectively. The described specimens are juvenile. *Raja radula* is rather uncommon in the area, juvenile specimens are only captured, generally during the night.

***Tab. 3: Total mass (in g) and measurements (in mm and as % DW) of two specimens of** R. radula **from Tunis Southern Lagoon.***
***Tab. 3: Celotna masa (v g) in meritve (v mm in % DW) pri dveh primerkih vrste** R. radula **iz Tuniške južne lagune.***

| **Cat. No.** | **RAJ-Rar-01** | | **RAJ-Rar-02** | |
|---|---|---|---|---|
| **Total mass (g)** | 14 | | 15 | |
| **Measurements** | mm | % DW | mm | % DW |
| Total length | 120 | 153.8 | 135 | 153.4 |
| Disk-length | 69 | 88.5 | 78 | 88.6 |
| Disk-width (DW) | 78 | 100.0 | 88 | 100.0 |
| Disk-depth | 8 | 10.3 | 9 | 10.2 |
| Eyeball length | 6 | 7.7 | 6.1 | 6.9 |
| Cornea | 3 | 3.8 | 3.3 | 3.8 |
| Pre-orbital length | 16 | 20.5 | 17.8 | 20.2 |
| Inter-orbital width | 6 | 7.7 | 6.6 | 7.5 |
| Spiracle length | 3.6 | 4.6 | 4 | 4.5 |
| Spiracle width | 1.4 | 1.8 | 1.6 | 1.8 |
| Inter-nasal width | | | | |
| Nasal curtain | 10.5 | 13.5 | 11.7 | 13.3 |
| Inter-spiracular width | 9 | 11.5 | 10.1 | 11.5 |
| Pre-oral length | 16.5 | 21.2 | 18.3 | 20.8 |
| Mouth width | 10 | 12.8 | 10.9 | 12.4 |
| First gill slit | 2 | 0.6 | 2 | 2.3 |
| Second gill slit | 2 | 0.6 | 2 | 2.3 |
| Third gill slit | 2 | 0.6 | 2 | 2.3 |
| Fourth gill slit | 1.5 | 1.9 | 1.5 | 1.7 |
| Fifth gill slit | 1.5 | 1.9 | 1.5 | 1.7 |
| Width between first gill slit | 19 | 24.4 | 21 | 23.9 |
| Width between fifth gill slit | 10 | 12.8 | 11.3 | 12.8 |
| Snout tip to eye | 17 | 21.8 | 19.1 | 21.7 |
| Snout tip to mouth | 17 | 21.8 | 19.5 | 22.2 |
| Snout tip to first gill slit | 26 | 33.3 | 29 | 33.0 |
| Snout tip to fifth gill slit | 32 | 41.0 | 36 | 40.9 |
| Snout tip to pelvic fin | 53 | 67.9 | 60 | 68.2 |
| Snout tip to vent | 54 | 69.2 | 61 | 69.3 |
| Pectoral fin anterior margin | 56 | 71.8 | 63 | 71.6 |
| Pectoral fin posterior margin | 40 | 51.3 | 45 | 51.1 |
| Pectoral fin inner margin | 12 | 15.4 | 14 | 15.9 |
| Pelvic fin anterior margin | 15 | 19.2 | 17 | 19.3 |
| Pelvic fin posterior margin | 16 | 20.5 | 18 | 20.5 |
| Pelvic fin inner margin | 9 | 11.5 | 10 | 11.4 |
| Span of pelvic fins | 35 | 44.9 | 39 | 44.3 |
| Tail base width | 5 | 6.4 | 6 | 6.8 |
| Tail base depth | 4 | 5.1 | 4.5 | 5.1 |
| Tail length | 67 | 85.9 | 75 | 85.2 |
| Snout tip to first dorsal | 10 | 12.8 | 12 | 13.6 |
| Snout tip to second dorsal | 11 | 14.1 | 13 | 14.3 |
| Superior caudal edge | 3 | 3.8 | 3 | 3.4 |
| Inferior caudal edge | 2 | 3.6 | 2.5 | 2.8 |
| First dorsal anterior edge | 9 | 11.5 | 10 | 11.4 |
| First dorsal posterior edge | | | | |
| First dorsal base | 5 | 6.4 | 6 | 6.8 |
| Second dorsal anterior edge | 6 | 7.7 | 7 | 7.9 |
| Second dorsal posterior edge | | | | |
| Second dorsal base | 5 | 6.4 | 5.5 | 6.3 |
| Inter-dorsal distance | 4 | 5.1 | 4 | 4.6 |
| Second dorsal to caudal birth | 5 | 6.4 | 6 | 6.8 |

**Family Dasyatidae**

**Common stingray *Dasyatis pastinaca* (Linnaeus, 1758)**

The specimen with Cat. No. DAS-Dap-01 (Fig. 8) was captured on 31 January 2004, close to the channel of communication with the sea. It was 352 mm DW and weighed 1652 g.

Disk rhomboid with anterior margins slightly convex at level of eyes and rounded at their distal end, while the posterior margins straight anteriorly and convex posteriorly. Snout minute and pointed. Pelvic fins quadrangular and with outer corner obviously rounded. Tail slender and slightly compressed dorso-ventrally. Dorsal surface of the tail with fold posterior to the sting but not extending to the end of the tail, ventral fold extending to the end of the tail. Disk-depth 15.1%, disk-length 86.6%, pre-oral length 19.6%, span of pelvic fins 39.7%, pelvic fin anterior margin 17.9%, ventral tail fold 34.1% all of disk-width. Pre-orbital length 0.95 times in interorbital width; preoral length 19.3 % disk-width, 1.01 times in interorbital width and 0.98 in width between first gill-slits. Snout angle in front of eyes 120°. Eyes moderately large, eyeball length 2.95 times in interorbital width; spiracles large, oblique and rather oval, 0.86 times in eyeball length, 2.95 times in interorbital width, 0.46 times in width between fifth gill slit. Mouth slightly arched, skin flap on upper jaws with 32 oral papillae. Five buccal papillae, three central elongated and a single one, verruca-like, on both side. Total tooth rows 48/52 in upper/lower jaws.

Dorsal surface rather olive-brown, fairly rosy along the margin of the pectoral fin and toward the snout; pelvic fins also beige with golden marks surrounding the eyes and along the mid-part of pectoral. Caudal sting beige. Belly off-white to beige with margins grey and tip of snout brownish.

Measurements, counts, description and colour are summarized in Table 4 and are in agreement with Tortonese (1956), Bini (1967), Capapé (1977a, 1983), Fischer *et al.* (1987), Cowley & Compagno (1993) and Golani & Capapé (2004).

The common stingray has often been reported from Tunisian waters, where it is commonly caught and landed at fishing sites located along the coast (Quignard & Capapé, 1971; Capapé, 1976b, 1977a; Bradaï, 2000).

However, the species is more abundant in the northern than in the southern area (Quignard & Capapé, 1971; Bradaï, 2000) and especially in the Gulf of Tunis. It sometimes enters estuarine waters, such as the River Miliane close to Tunis, in order to expel its near-term embryos (see Capapé *et al.*, *in press*). Data on the reproductive biology and diet and feeding habits of the Gulf of Tunis specimens had been previously provided (Capapé, 1975, 1976b). The specimen is an adult male (see Capapé, 1976b). The common stingray is occasionally captured in the Tunis Southern Lagoon.

***Tab. 4: Total mass (in g), measurements (in mm and as % DW) and counts of** D. pastinaca **from Tunis Southern Lagoon.***
***Tab. 4: Celotna masa (v g), dimenzije (v mm in % DW) in meristični podatki pri vrsti** D. pastinaca **iz Tuniške južne lagune.***

| **Cat. No.** | **DAS-Dap-01** | |
|---|---|---|
| **Total mass (g)** | 1652 | |
| **Measurements** | mm | % DW |
| Total length | 660 | 187.5 |
| Disk-length | 305 | 86.6 |
| Disk-width | 352 | 100.0 |
| Disk-depth | 53 | 15.1 |
| Eyeball width | 22 | 6.3 |
| Cornea | 12 | 3.4 |
| Pre-orbital length | 68 | 19.3 |
| Inter-orbital width | 65 | 18.5 |
| Spiracle length | 19 | 5.4 |
| Spiracle width | 13 | 3.7 |
| Inter-nasal width | 35 | 9.9 |
| Nasal curtain | 40 | 11.4 |
| Interspiracular width | 63 | 17.8 |
| Pre-oral length | 69 | 19.6 |
| Mouth width | 36 | 10.2 |
| First gill slit | 10 | 2.8 |
| Second gill slit | 11 | 3.1 |
| Third gill slit | 12 | 3.4 |
| Fourth gill slit | 12 | 3.4 |
| Fifth gill slit | 8 | 2.3 |
| Width between first gill slit | 70 | 19.9 |
| Width between fifth gill slit | 41 | 11.6 |
| Snout tip to eye | 81 | 23.0 |
| Snout tip to mouth | 71 | 20.2 |
| Snout tip to first gill slit | 120 | 34.0 |
| Snout tip to fifth gill slit | 155 | 44.0 |
| Snout tip to pelvic fin | 262 | 74.4 |
| Snout tip to sting | 403 | 114.5 |
| Sting length | 101 | 28.7 |
| Snout tip to vent | 275 | 78.1 |
| Pectoral fin anterior margin | 231 | 65.6 |
| Pectoral fin posterior margin | 216 | 61.4 |
| Pectoral fin inner margin | 45 | 12.8 |
| Pelvic fin anterior margin | 63 | 17.9 |
| Pelvic fin posterior margin | 36 | 10.2 |
| Pelvic fin inner margin | 24 | 6.8 |
| Pelvic fin base | 60 | 17.0 |
| Span of pelvic fins | 155 | 44.0 |
| Clasper length | 121 | 34.3 |
| Tail base width | 30 | 8.5 |
| Tail base depth | 16 | 4.5 |
| Tail length | 382 | 108.5 |
| Ventral tail fold length | 120 | 34.1 |
| Dorsal tail fold length | 72 | 20.5 |
| **Counts** | | |
| Oral papillae | 32 | |
| Buccal papillae | 1+4+1 | |
| Teeth rows upper jaw | 48 | |
| Teeth rows lower jaw | 52 | |

**Family Myliobatidae**

**Bull ray *Pteromylaeus bovinus* (E. Geoffroy Saint-Hilaire, 1817)**

The specimen with Cat. No. MYL-Ptb-01 (Fig. 9) was captured on 20 April 2003 by tramail. It was 310 mm DW and weighed 416 g.

Disk lozenge-shaped with anterior margin strongly convex and pectoral strongly falciform especially at their distal end, while posterior margin strongly concave posteriorly not continuous with rostral fins at side of head. Snout produced, narrower than the skull, blunted at the end. Pelvic fins quadrangular and with outer corner rounded. Tail slender rather rounded and slightly compressed dorso-ventrally, bearing on the dorsal part a small dorsal fin and a serrated sting behind it. Disk-depth 14.5%, disk-length 63.5%, pre-oral length 11.6%, span of pelvic fins 22.6%, pelvic fin anterior margin 11.9% all of disk-width. Pre-orbital length 0.91 times in interorbital width; pre-oral length 11.6% disk-width, 1.1 times in interorbital width and 10.2 times width between fifth gill-slits spiracles length 1.3 times. Snout angle 90°. Eyes prominent lateral, eyeball length 1.2 times in interorbital width; spiracles large opening laterally, 1.2 times in eyeball length, 1.4 times in interorbital width, 0.13 times width between fifth gill-slit. Anterior nasal valves confluent, free behind. Mouth slightly arched 1.6 times in pre-oral length, 129% in nasal curtain length. Tail length 69.4% in total length, 2.2 times in disk-length and 1.3 times in disk-width. Dorsal fin originating before pelvic fin tip. Teeth tesselate in seven rows in both jaws.

Dorsal surface rather brownish with four olive transverse stripes on head and seven on disk. Tail and dorsal fin uniformly brownish. Sting beige.

Measurements, counts, description and colour are summarized in Table 5 and are in agreement with Tortonese (1956), Bini (1967), Capapé & Quignard (1975) and Fischer *et al.* (1987).

The bull ray is commonly captured in southern Tunisia, especially in the Gulf of Gabès, slightly less in the Gulf of Hammamet and rarely in the Gulf of Tunis, in spring and summer, generally. With regard to the specimens from the first area, aspects of reproductive biology were reported by Capapé & Quignard (1975), while their diet and feeding habits were studied by Capapé (1977b). Capapé & Quignard (1975) noted that size at birth occurs between 270 and 290 mm in Tunisian waters and according to Seck *et al.* (2002) between 250 and 270 mm TOT, in Senegalese waters. The specimen described above exhibited an unhealed scar on the ventral surface. It was a neonate and probably the smallest free-swimming *Pferomylaeus bovinus* recorded to date, 310 mm disk-width and 410 g in mass (see Tab. 5); the previous one being of Seck *et al.* (2002): 355 mm disk-width and 460 g, from off Senegal. All the 14 observed

***Tab. 5: Total mass (in g) and measurements (in mm and as % DW) of** P. bovinus **from Tunis Southern Lagoon.***
***Tab. 5: Celotna masa (v g) in dimenzije (v mm in % DW) pri vrsti** P. bovinus **iz Tuniške južne lagune.***

| **Cat. No.** | **MYL-Ptb-01** | |
|---|---|---|
| **Total mass (g)** | 416 | |
| **Measurements** | mm | % DW |
| Total length | 592 | 191.9 |
| Disk-length | 187 | 67.3 |
| Disk-width | 310 | 100.0 |
| Disk-depth | 45 | 14.5 |
| Maximum snout width | 51 | 16.5 |
| Dorsal snout width | 37 | 11.9 |
| Snout length | 18 | 5.8 |
| Snout depth | 10 | 3.2 |
| Snout tip to pectoral | 46 | 14.8 |
| Cephalic fin length | 40 | 12.9 |
| Anterior interspiracular width | 17 | 5.5 |
| Posterior interspiracular width | 23 | 7.4 |
| Eyeball length | 27.5 | 8.9 |
| Eyeball width | 13 | 4.2 |
| Cornea length | 9 | 2.9 |
| Cornea width | 7 | 2.3 |
| Pre-orbital length | 30 | 9.7 |
| Inter-orbital width | 33 | 10.6 |
| Spiracle length | 23 | 7.4 |
| Spiracle width | 7 | 2.5 |
| Inter-nasal width | 32 | 10.3 |
| Nasal curtain | 17 | 5.5 |
| Pre-oral length | 36 | 11.6 |
| Mouth width | 22 | 7.1 |
| First gill slit | 6 | 1.9 |
| Second gill slit | 5 | 1.6 |
| Third gill slit | 5 | 1.6 |
| Fourth gill slit | 5 | 1.6 |
| Fifth gill slit | 2 | 0.6 |
| Width between first gill slit | 47 | 1.6 |
| Width between fifth gill slit | 30 | 0.9 |
| Snout tip to eye | 31 | 10.0 |
| Snout tip to mouth | 36 | 11.6 |
| Snout tip to first gill slit | 63 | 20.3 |
| Snout tip to fifth gill slit | 83 | 26.8 |
| Snout tip to pelvic fin | 161 | 51.9 |
| Snout tip to sting | 225 | 72.6 |
| Snout tip to dorsal | 174 | 56.1 |
| Snout tip to vent | 163 | 52.6 |
| Pectoral fin anterior margin | 160 | 51.6 |
| Pectoral fin posterior margin | 150 | 48.4 |
| Pectoral fin inner margin | 23 | 7.4 |
| Pelvic fin anterior margin | 37 | 11.9 |
| Pelvic fin posterior margin | 25 | 8.1 |
| Pelvic fin inner margin | 18 | 5.8 |
| Span of pelvic fins | 70 | 22.6 |
| Clasper length | 18 | 5.8 |
| Tail base width | 12 | 3.9 |
| Tail base depth | 10 | 3.2 |
| Tail length | 411 | 132.6 |
| Sting length | 5 | 1.6 |
| Dorsal anterior edge | 17 | 5.5 |
| Dorsal posterior edge | 12 | 3.9 |
| Dorsal inner edge | 1 | 0.3 |
| Dorsal base | 30 | 9.7 |

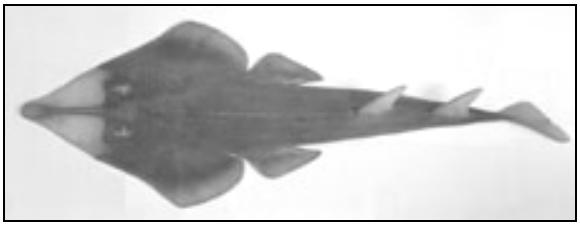

***Fig. 3: Blackchin guitarfish*** *R. cemiculus* ***(E. Geoffroy Saint-Hilaire, 1817).***
***Sl. 3: Vrsta*** *R. cemiculus* ***(E. Geoffroy Saint-Hilaire, 1817).***

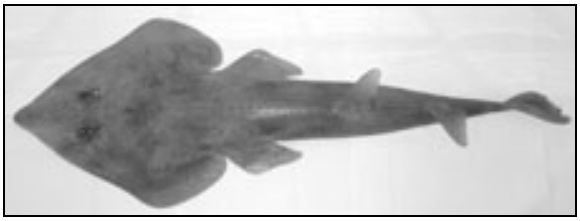

***Fig. 4: Common guitarfish*** *R. rhinobatos* ***(Linnaeus, 1758).***
***Sl. 4: Vrsta*** *R. rhinobatos* ***(Linné, 1758).***

***Fig. 5: Marbled electric ray*** *T. marmorata* ***(Risso, 1810).***
***Sl. 5: Navadni električni skat*** *T. marmorata* ***(Risso, 1810).***

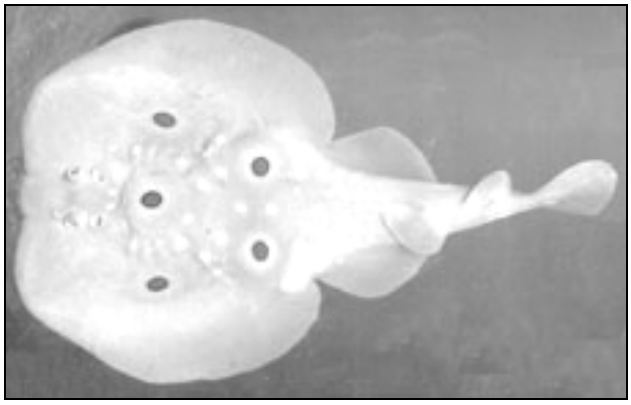

***Fig. 6: Common torpedo*** *T. torpedo* ***(Linnaeus, 1758).***
***Sl. 6: Pegasti električni skat*** *T. torpedo* ***(Linné, 1758).***

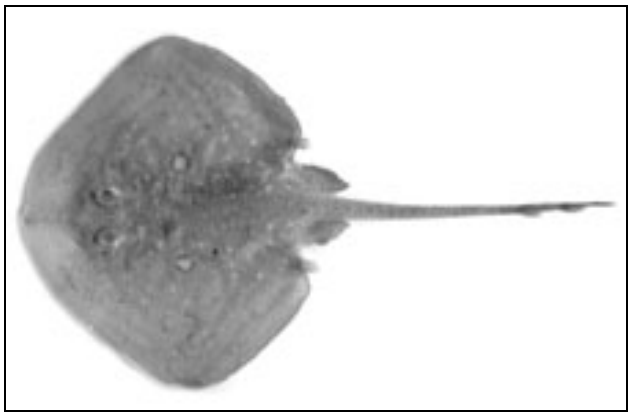

***Fig. 7: Rough ray*** *R. radula* ***(Delaroche, 1809).***
***Sl. 7: Vrsta skata*** *R. radula* ***(Delaroche, 1809).***

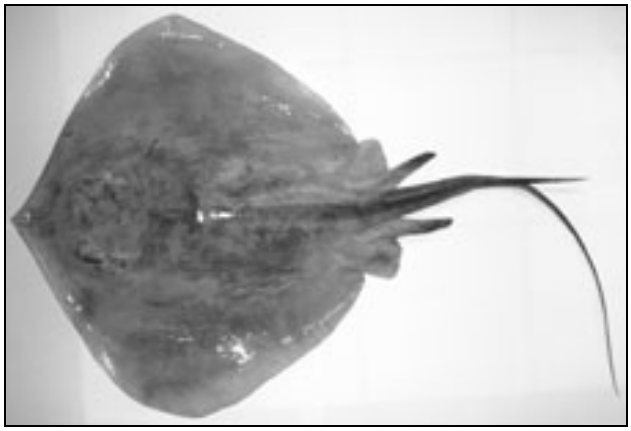

***Fig. 8: Common stingray*** *D. pastinaca* ***(Linnaeus, 1758).***
***Sl. 8: Navadni morski bič*** *D. pastinaca* ***(Linné, 1758).***

***Fig. 9: Bull ray*** *P. bovinus* ***(E. Geoffroy Saint-Hilaire, 1817).***
***Sl. 9: Kljunati morski golob*** *P. bovinus* ***(E. Geoffroy Saint-Hilaire, 1817).***

specimens were juveniles referring to previous observations of Capapé & Quignard (1975) and Seck *et al.* (2002). Their disk width ranged from 310 to 497 mm (mean 410.5 ± 45.5 mm) and their mass from 416 to 883 g (mean: 779 ± 160.9 g). The relationship total mass (TM) *vs.* disk width (DW) is: TM (g) = 415.7 DW (mm) - 2603.10; n = 14; r = 0.91.

## DISCUSSION

Prior to its environmental restoration, the Tunis Southern Lagoon was close to the stage of collapse and in danger of becoming completely azoic. The recent occurrence of a large biodiversity, comprising benthic invertebrates and fish fauna, shows that water quality was successfully improved in the area (Ben Souissi *et al.*, 2003; Ben Souissi *et al.*, *in press)*. Moreover, the large number of fish species recorded in the Tunis Southern Lagoon shows that it is now subjected to strong influence of marine flux. This phenomenon has been confirmed by the occurrence of seven elasmobranch species, previously unknown in the area.

Most of the observed specimens in each species were juvenile. Their small sizes allowed them to enter the channel of communication between the area and the Gulf of Tunis, in order to take refuge in the Tunis Southern Lagoon and to avoid both interspecific competition pressure and predation risk by larger elasmobranch species, such as sharks. By contrast, the occurrence of small free-swimming specimens, such as *R. radula* and *P. bovinus* (probably neonates), did not allow us to believe that they were born in the Tunis Southern Lagoon, as no adult females of both species were found, but close to the communication channel with the sea.

Three species, *T. torpedo, R. rhinobatos* and *P. bovinus*, only are relatively abundant in the Tunis Southern Lagoon. The first species was abundant in other Tunisian lagoons, such as the Lagoon of Bizerte in northern Tunisia (Ben Brahim & Capapé, 1997; Ben Brahim *et al.*, 1998; Capapé *et al.*, *in press*) and the Bahiret El Biban, southern Tunisia, the second species was captured in the latter area only where it lives and reproduces (Capapé *et*

*al.*, 1997; Capapé *et al.*, *in press*), concomitantly with its close relative species *R. cemiculus* (Capapé & Zaouali, 1994; Capapé *et al.*, *in press*). Although *T. torpedo*, *R. rhinobatos* and *P. bovinus* could be considered permanently present in the area and grew normally (see relationship size *vs.* mass), no sufficient data are available at present to suggest that sustainable populations are definitely established in the area. Further investigations are needed in order to state, whether or not, they are neocolonisers in the Tunis Southern Lagoon.

The scarcity of *T. marmorata* and *R. cemiculus* in the area is probably due to the interspecific competition pressure with *T. torpedo* for the former and with *R. rhinobatos* for the latter. Moreover, this may be due to fact that *T. marmorata* and *R. cemiculus* are considered to be less abundant in the Gulf of Tunis, which is the source of the seven elasmobranch species recorded in the area. By contrast, *P. bovinus* is less abundant in the Gulf of Tunis than the common eagle ray *Myliobatis aquila* (Linnaeus, 1758) according to Capapé & Quignard (1974, 1975) and Bradaï (2000). Moreover, although *P. bovinus* was rather common in the Gulf of Gabès (Capapé & Quignard, 1975; Bradaï, 2000), it was never recorded in the Bahiret El Biban (Capapé *et al.*, *in press*). *P. bovinus* probably takes refuge in the Tunis Southern Lagoon in order to avoid competition pressure with *M. aquila*, which is more abundant in the area, but both species feed on same preys (Capapé, 1976c, 1977b). On the other hand, specific changes in fish diversity cannot be excluded in the Gulf of Tunis, such as in the Adriatic Sea (Lipej & Dulčić, 2004). Further, Quignard & Capapé (1971), Capapé & Quignard (1975) and Capapé *et al.* (1981) noted *R. cemiculus*, R. *rhinobatos* and *P. bovinus* very common in the Gulf of Gabès and rather rare in the Gulf of Tunis. According to Postel (1956), Ben Othman (1973) and Bradaï (2000), the waters of Gulf of Gabès are considered to have sub-tropical affinities. Migrations of exotic species, such as Lessepsian migrants or originating from the eastern tropical Atlantic, are regularly reported from off the northern Maghrebine shore (Hemida *et al.*, 2002, 2003; Bradaï *et al.*, 2004). Migration of species from the Gulf of Gabès to northernmore areas remains a suitable hypothesis. So, the occurrence of these species, and especially the two latter species that are rather common in Tunis Southern Lagoon, could be considered only as a conjunctural phenomenon. The neo-colonisation of the Tunis Southern Lagoon by benthic invertebrates originating from the Red Sea could also partially explain this occurrence (see Ben Souissi *et al.*, 2003). Since the 1960s, Tunisian waters have been regularly invaded by new Lessepsian species, as reported in some previous papers (see Bradaï *et al.*, 2004). This phenomenon was observed in several Mediterranean areas (see Quignard & Tomasini, 2000; Dulčić *et al.*, 2003; Lipej & Dulčić, 2004) and is probably due to the fact that inshore and offshore waters become warmer (see Francour *et al.*, 1994). In the Tunis Southern Lagoon, however, no significant changes in water temperature were clearly observed before and after the environmental restoration. The Tunis Southern Lagoon, recently subjected to a large marine flux, is probably becoming a trophic area (*sensu* Guélorget & Perthuisot, 1983, 1992), where predators such as elasmobranchs species find sufficient food. Nevertheless, further investigations are needed in order to show whether the elasmobranch species recorded to date are permanent inhabitants in the area and whether they could finally be considered paralic species (*sensu* Guélorget & Perthuisot, 1983, 1992), such as those of the Bahiret El Biban (Capapé & Zaouali, 1994, 1995; Capapé *et al.*, *in press)*.

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# O NEDAVNEM POJAVLJANJU RAZLIČNIH VRST SKATOV V TUNIŠKI JUŽNI LAGUNI (SEVERNA TUNIZIJA, SREDNJE SREDOZEMLJE)

*Hamadi MEJRI, Jamila BEN SOUISSI & Jeanne ZAOUALI*

Département des Ressources Animales, Halieutiques et des Technologies Agro-alimentaires, Institut National Agronomique de Tunisie, 43 avenue Charles Nicolle, 1082 Tunis, Tunisie

*Amor El ABED*

Institut des Sciences et Technologies de la Mer, 2025 Salammbô, Tunisie

*Yvan VERGNE, Olivier GUÉLORGET & Christian CAPAPÉ*

Laboratoire d'Ichtyologie, case 104, Université Montpellier II, Sciences et Techniques du Languedoc, F-34 095 Montpellier cedex 05, France

E-mail: capape@univ-montp2.fr

*POVZETEK*

*Med raziskavami, opravljenimi po okoljski obnovi Tuniške južne lagune, ki meji na Tuniški zaliv (severna Tunizija), je bilo v laguni prvič zabeleženih sedem vrst hrustančnic, in sicer:* Rhinobatos cemiculus, R. rhinobatos, Torpedo marmorata, T. torpedo, Raja radula, Dasyatis pastinaca *in* Pteromylaeus bovinus. *Za tri izmed njih,* R. rhinobatos, T. torpedo *in* P. bovinus, *se zdi, da stalno živijo v tem območju. Avtorji opisujejo vseh sedem vrst in razglabljajo o vzrokih za nenavadno pojavljanje teh vrst.*

**Ključne besede:** hrustančnice, okoljska obnova, Tuniška južna laguna, Tunizija, Sredozemlje

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# ON A GREAT WHITE SHARK, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758), TRAPPED IN A TUNA CAGE OFF LIBYA, MEDITERRANEAN SEA

*Txema GALAZ*
Tuna Farms of Mediterraneo, E-San Javier 30730 Murcia, c/Sierra de la Pila no. 39, Spain

*Alessandro DE MADDALENA*
Banca Dati Italiana Squalo Bianco (Italian Great White Shark Data Bank), I-20145 Milano, via L. Ariosto 4, Italy
E-mail: a-demaddalena@tiscali.it

## *ABSTRACT*

*On June 12, 2002, a towing boat on its way from Libya to Spain stopped at 33º 50´ N, 13º 50´ E, 55 miles off Tripoli, for a check of its 50-m diameter tuna cage containing 60 tons of blue-fin tuna. Here, an estimated 5-m female long white shark suddenly tore the net and entered the cage, where the tuna farm staff then observed it for 2.5 hours. Photographic and filmed evidence was collected. The towing boat continued its journey, and two days later the shark left the cage. Other cases of sharks trapped in tuna cages in the Mediterranean include two blue sharks in a cage between Italy and Spain in 2001, and a shortfin mako in a cage between the Baleares Islands and Murcia, Spain, in 2002. The vulnerable status of white sharks in the Mediterranean necessitates monitoring of the interactions between white sharks and the tuna farm industry, in order that an appropriate action is taken during the attempts to release sharks trapped in tuna cages.*

**Key words:** great white shark, *Carcharodon carcharias*, tuna farm, Mediterranean Sea

# SU DI UNO SQUALO BIANCO, *CARCHARODON CARCHARIAS* (LINNAEUS, 1758), INTRAPPOLATO IN UNA GABBIA PER TONNI AL LARGO DELLA COSTA LIBICA, MARE MEDITERRANEO

## *SINTESI*

*Il 12 Giugno 2002, una gabbia per tonni di 50 m di diametro contenente 60 tonnellate di tonni rossi si trovava a 33º 50´ N, 13º 50´ E, 55 miglia al largo di Tripoli, Libia, quando venne fermata per un controllo. Qui una femmina di squalo bianco di lunghezza stimata intorno a 5 m ruppe la rete ed entrò nella gabbia, dove lo staff della tuna farm la osservò per 2,5 ore. Testimonianza fotografica e filmata venne raccolta. La nave rimorchio continuò il suo viaggio e due giorni dopo lo squalo aveva riguadagnato la libertà. Altri casi di squali intrappolati in gabbie per tonni nel Mediterraneo comprendono due verdesche in una gabbia tra Italia e Spagna nel 2001, e un mako dalle pinne corte in una gabbia tra le Isole Baleari e Murcia, Spagna, nel 2002. Lo stato vulnerabile dello squalo bianco nel Mediterraneo rende necessario monitorare le interazioni tra squali bianchi e allevamenti di tonni in modo tale da intraprendere azioni appropriate per rilasciare gli squali quando questi restino intrappolati nelle gabbie per tonni.*

**Parole chiave:** squalo bianco, *Carcharodon carcharias*, tuna farm, Mare Mediterraneo

## INTRODUCTION

There have been several reports of great white sharks *Carcharodon carcharias* (Linnaeus, 1758) (order Lamniformes, family Lamnidae) being captured in tuna tow cages and in inshore tuna farm cages. Exact numbers are not known, as captures are not always reported. In some cases, tuna farm staff attempted to release white sharks trapped in tuna cages, but it is only recently that successful releases have occurred (K. Rodda, *pers. comm.)*. Malcolm *et al*. (2001) reported nine confirmed captures by tuna farm industry over a period of about five years: in six of these cases, the shark was killed, while in three cases the shark was already dead. A large great white shark was killed in a tuna cage off South Australia in October 2002 (Gorton, 2003b). A 3.8 m male great white shark apparently drowned or died due to the stress in a tow cage off Boston Island, South Australia, in January 2003 (Gorton, 2003a). On 19 June, 2003, a 4.4 m female great white shark was trapped in an experimental tuna farm cage of the South Australian Research and Development Institute (SARDI) off Port Lincoln, South Australia, and remained in it until 24 June, when the attempts to release it finally proved successful (K. Rodda, *pers. comm.;* I. Gordon, *pers. comm.)*. On 30 June, 2003, a 5.5-m female great white shark was caught inside a blue tuna cage, 300 miles offshore in front of Coronado Islands, Mexico; due to its large size, the tuna farm staff could not find a way to release it and eventually decided to kill it (J. L. Castillo-Geniz, *pers. comm.)*. Another white shark, estimated to be over 4 m long, was trapped in a tuna cage, containing no tuna, off Port Lincoln, South Australia, in September 2003, and set free (Gorton, 2003c). In May 2004, two 4-m white sharks were trapped in a tuna cage off Port Lincoln, South Australia, and both were released (K. Rodda, *pers. comm.*; Gorton, 2004a, b). In August 2004, about 3-m white shark was trapped in a tuna cage near Port Lincoln, South Australia, and released (K. Rodda, *pers. comm.*; Gorton, 2004a, b).

In recent years, the great white shark has been the subject of several studies in the Mediterranean Sea, focusing on different aspects of its biology and ecology (Fergusson, 1996; Mojetta *et al*., 1997; De Maddalena, 2000a, b; Storai *et al*., 2000; Barrull & Mate, 2001; Celona *et al*., 2001; De Maddalena *et al*., 2001; Celona, 2002; De Maddalena, 2002; Soldo & Jardas, 2002a, b; Kabasakal, 2003). However, relationships between great white sharks and tuna farms in the Mediterranean have never been described. In the present paper, we present the case of a great white shark trapped in a tuna cage off the Libyan coast.

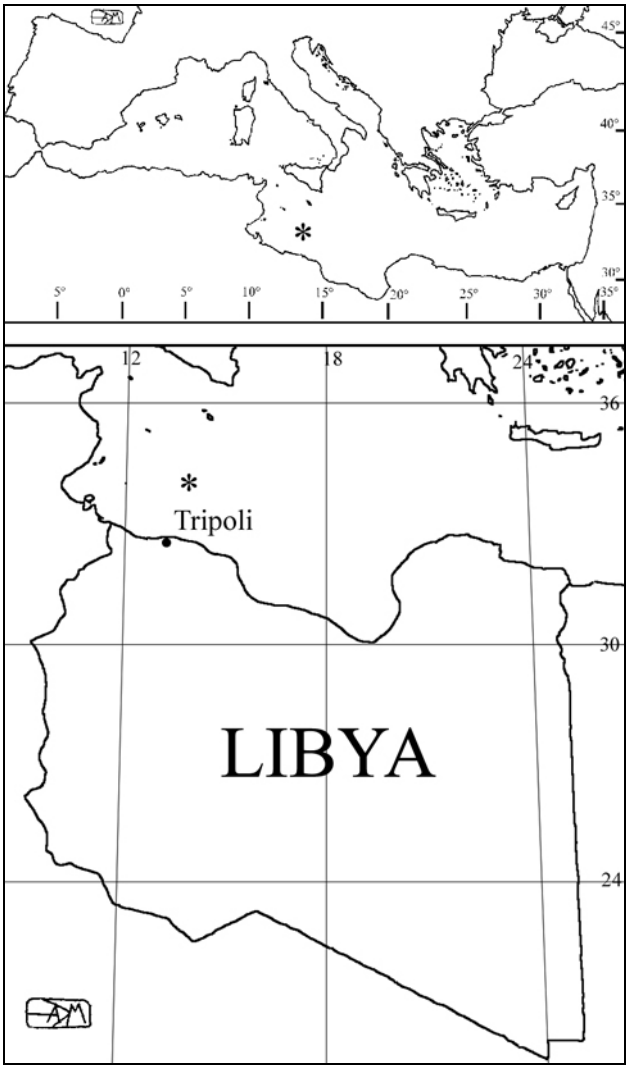


***Fig. 1: Maps of the Mediterranean Sea and Libya showing the locality where an estimated 5-m long great white shark*** *Carcharodon carcharias* ***was trapped in a tuna cage, at 33º50´ N, 13º50´ E, 55 miles off Tripoli, Libya. (Drawing: A. De Maddalena)***
***Sl. 1: Zemljevida Sredozemskega morja in Libije z lokaliteto na zemljepisni točki 33º50´ N, 13º50´ E, 55 milj od Tripolija, kjer se je v kletko za tune ujel 5 m dolg beli morski volk*** *Carcharodon carcharias****. (Risba: A. De Maddalena)***

## MATERIALS AND METHODS

Information and photographic evidence of a great white shark trapped in a tuna tow cage on 12 June, 2002, at 33º50´ N, 13º50´ E, 55 miles off Tripoli, Libya, are presented. The information is based on direct observations of the specimen by one of the authors (T. Galaz). The size of the shark was estimated following close examination and by comparison with tuna cage's parts of

known size. It was also possible to collect photographs, including underwater pictures, and a video of the shark swimming inside the cage.

## RESULTS

In summer 2002, a 50-m diameter tuna cage belonging to a European tuna farm, was being towed from Libya to Spain. In the morning of 12 June, when the tuna cage was located at 33º50´ N, 13º50´ E, 55 miles off Tripoli, Libya (Fig. 1), the towing boat was stopped for a check of the tuna cage. During the past 5 days, bad weather hindered the tuna farm company's staff to check the cage, but on that day it was sunny and calm.

Here one of the authors went with some divers to check the cage containing 60 tons of blue-fin tuna, *Thunnus thynnus*. When the author dived into the cage for the first check, he did not see anything unusual, but

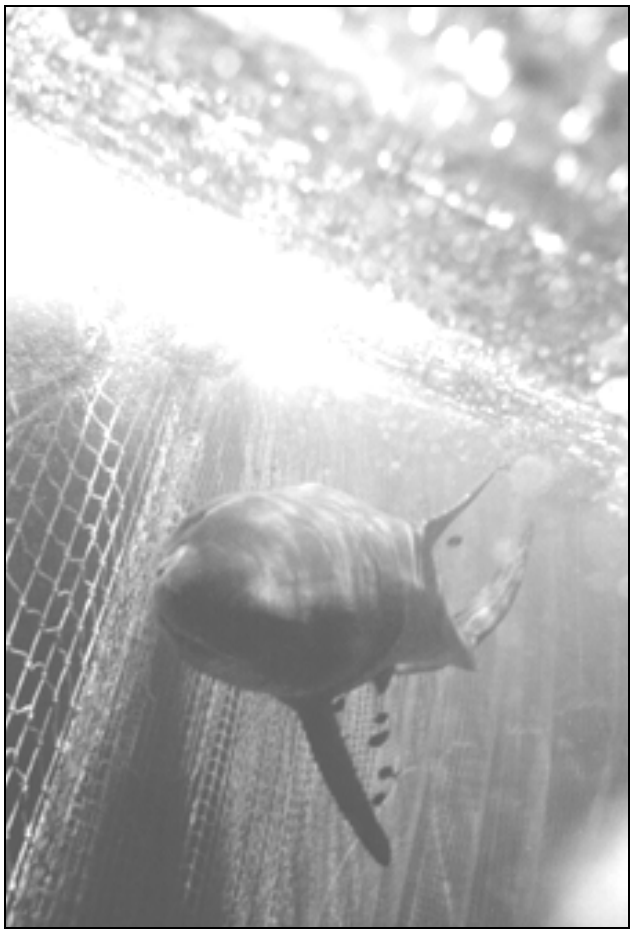

***Fig. 2: An estimated 5 m long great white shark swimming in a 50 m diameter tuna cage off Tripoli, Libya. (Photo: L. Millan)***
***Sl. 2: Kakih 5 m dolg beli morski volk plava v tunji kletki s premerom 50 m, 55 milj od Tripolija, Libija. (Foto: L. Millan)***

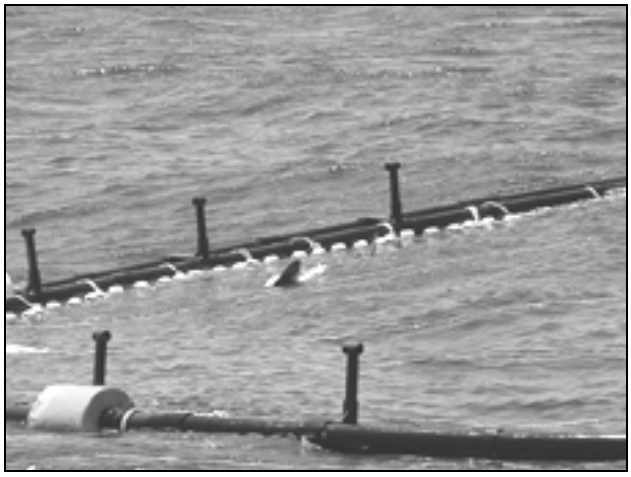

***Fig. 3: An estimated 5 m long great white shark swimming slowly in circle, with its dorsal and caudal fin protruding above the surface, in a 50 m diameter tuna cage. (Photo: T. Galaz)***
***Sl. 3: Petmetrski beli morski volk med počasnim krožnim plavanjem v tunji kletki s premerom 50 m, s hrbtno in repno plavutjo štrlečo iz vode. (Foto: T. Galaz)***

he ordered some divers to proceed to the bottom of the net to take out some dead tunas. It was about 10:00 am. When the divers reached the bottom, they suddenly noticed a large white shark breaking the net there, and it took only 5 seconds to enter the tuna cage. It is likely that the white shark had followed the tuna cage for quite some time and tore the net when the boat stopped. As soon as the shark entered the cage, tuna became alarmed, and the divers left the cage. The author and the rest of the tuna farm company's staff remained at the cage for about two hours and a half, watching the shark's movements. It began to swim in circles inside the cage, initially about 20 m deep, then moving closer to the surface. After some 5 minutes from its arrival, the shark rapidly snapped at the net, but only after a couple of seconds it continued to swim, without showing any desire to tear the net. The large predator appeared relaxed, and simply continued to swim about 1 to 2 m deep near the inside edge of the cage, coming to the surface a couple of times.

The shark was observed closely and its total length was estimated at about 5 m. Although it was watched for a long time, it was impossible to see its claspers to determine its sex, but considering that in males of this size the claspers are very long and well developed, the dealt with specimen was most probably a female. A couple of underwater photographs were taken by immersing the camera in the water from the surface (Fig. 2). Some additional non-underwater photos of the shark swimming slowly in the cage with its dorsal fin protruding above the surface were also made (Fig. 3) and a low-quality

video shot. Surprisingly, the tunas soon calmed down.

They no longer seemed to be nervous due to the presence of the large predator so close to them, and merely swam as far as possible from it. No tuna escaped through the relatively small hole made by the shark on the bottom of the cage (they simply avoided to swim close to the net, as they usually do). The shark was not seen attacking any tuna, but it could not be excluded that it fed on one or more tuna during the time it remained inside the cage. The shark was possibly more concerned with the fact that it was trapped in the cage than paying attention to its potential prey. However, during the time when observed it made no attempt to break the net, even though this was surely no great obstacle for it, considering the ease it showed in tearing the net when it entered. Then the tuna farm staff left the cage alone, and the towing boat was ordered to continue its journey. As soon as it moved on, the shark seemed fairly uncomfortable in the cage. Two days later, however, the shark was no longer in the tuna cage. It is not known when it actually left it, but in order to get out of it, the predator made a hole in the net, on the lateral wall of the cage.

In the nine years spent by one of the authors (T. Galaz) in Mediterranean tuna farming, this is the first time that such an event, involving a great white shark, was observed. Other cases of sharks trapped in tuna cages in the Mediterranean Sea included the following: in 2001, two blue sharks *Prionace glauca* entered a tuna cage being towed from Italy to Spain; and in 2002, a 40 kg shortfin mako *Isurus oxyrinchus* entered a tuna cage between Baleares Island and Murcia, Spain.

## DISCUSSION

The described event is one of the very few cases in which a great white shark was observed for an extended time in a captive condition. Great white sharks are particularly difficult to keep in captivity because they need to make fast movements to stay alive (Ellis & McCosker, 1991). Only 16% of great white sharks were alive when found in the protective nets off Natal, South Africa (Cliff *et al.*, 1989) and this low percentage reflects their high oxygen requirements (at the time of writing only the Monterey Bay Aquarium, California, has succeeded in keeping a great white shark alive in captivity for over two months and a half).

Concerning the white shark's behaviour, it was similar to the one described for the 4.4-m female specimen trapped in an experimental tuna farm of the SARDI off Port Lincoln, South Australia, from 19 to 24 June, 2003 (I. Gordon, *pers. comm.;* K. Rodda, *pers. comm.).* Both sharks entered the cage by making a small hole in the net, strictly adequate for them to enter through it, both sharks appeared relaxed and swam slowly near the inside edge of the cage, and in both cases the captive white sharks neither killed nor disturbed the tuna in the cage.

It is interesting to note that of the 466 records of white sharks in the Mediterranean Sea collected in the Italian Great White Shark Data Bank, while the cases accompanied by photographic evidence are numerous, in only three of these cases the photos are underwater pictures. A female white shark was filmed by Michel Lobreaux off Favignana, Egadi Islands, Italy, in the late 1960s and the sequence was included in the documentary *"Uomini e squali"* by the Italian director Bruno Vailati (S. Carletti, *pers. comm.);* an estimated 5-m female white shark was photographed in the shallow waters of Pantelleria, Italy, in July 1991 (R. Andreoli, *pers. comm.);* an estimated 5-m white shark was photographed off Strombolicchio, Eolie Islands, Italy in June 1995 or 1996, but unfortunately the picture seems to be lost (De Maddalena, 2002). Therefore the photo featured in this work is one of the few underwater image of a live white shark made in the Mediterranean Sea.

According to Malcolm *et al.* (2001), unsubstantiated reports have been made in Australia on up to 10-20 captures of white sharks by tuna farm industry and multiple interactions each year. Tuna farm industry has been only recently developed in the Mediterranean Sea, with the first tuna farm established in this area in 1995. Nowadays, tuna farming in the Mediterranean involves Spain, Italy, Croatia, Turkey, Cyprus, Greece, Tunisia and Libya. The paucity of great white sharks in the Mediterranean Sea makes the capture of white sharks in tuna cages in this area a rare event. However, further work is required to accurately estimate the number of sharks that may be trapped in tuna cages. Tuna has always been a primary food source for Mediterranean white sharks, and interactions between these large predators and tuna-traps, once numerous in the area, have been described in details (Barrull & Mate, 2001; De Maddalena, 2000a, 2002). Even considering that white sharks are now less abundant in the Mediterranean Sea than they were in the 19$^{th}$ and in the first half of the 20$^{th}$ century, we may therefore expect a higher number of interactions between these cartilaginous fishes and the newborn tuna farm industry. We expect that other cases will be reported in the near future. However, the lack of reports concerning relationships between sharks in general and tuna farms in the Mediterranean is an additional evidence of the alarming paucity of these cartilaginous fishes in these waters.

The great white shark is a protected species in Australia, and the Primary Industries and Resources South Australia issued a protocol for any interactions between tuna cages and sharks or marine mammals to be reported, so that appropriate action can be taken. The vulnerable status of white sharks in the Mediterranean Sea, its inclusion in the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterra-

nean of the Barcelona Convention as a species in need of protection, the protection of the species in Italy and Malta, and the recent proposal by the Convention on International Trade in Endangered Species (CITES) for a regulation of the international trade in great white sharks, necessitate monitoring of the interactions between white sharks and tuna farm industry. When a white shark is trapped in a tuna cage, attempts to release it have to be made, even though the attempt to remove a great white shark from a tuna cage is a difficult task and may sometimes present a notable risk to the people involved. There is the possibility to design new tuna cages with shark escape hatches built in them, if found to be practical. A possible kind of opening could be similar to the one that allowed a successful release of the white shark trapped in a tuna cage off Port Lincoln in June 2003. The gate opening was made in such a way that it was 9 m deep, then ropes were attached to the following edge at the top and bottom, so that when it was pulled it drew the gate open inwards and formed a V-shaped tunnel, expanding the opening, so that the shark would have a greater chance of seeing it swimming into or sense the net wall (about 3 m long) and turn away from it through the opening (I. Gordon, *pers. comm.;* K. Rodda, *pers. comm.).*

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# O BELEM MORSKEM VOLKU, *CARCHARODON CARCHARIAS* (LINNÉ, 1758), UJETEM V TUNJI KLETKI V VODAH SREDOZEMSKEGA MORJA SEVERNO OD LIBIJE

*Txema GALAZ*
Tuna Farms of Mediterraneo, E-San Javier 30730 Murcia, c/Sierra de la Pila no. 39, Spain

*Alessandro DE MADDALENA*
Banca Dati Italiana Squalo Bianco (Italian Great White Shark Data Bank), I-20145 Milano, via L. Ariosto 4, Italy
E-mail: a-demaddalena@tiscali.it

*POVZETEK*

*Na zemljepisni točki 33º 50´ N, 13º 50´ E, 55 milj od Tripolija, se je dne 12. junija 2002 med plovbo iz Libije v Španijo ustavil vlačilec, da bi pregledali kletko s premerom 50 m, ki so jo vlekli za seboj in v kateri je bilo 60 ton modroplavutih tun. Ko so se potapljači, uslužbenci neke evropske tunje farme, spustili h kletki, so ob njej nenadoma opazili kakih 5 metrov dolgo samico belega morskega volka. Zlahka je raztrgala mrežo in splavala v kletko, kjer so jo potapljači potem opazovali še dve uri in pol. Napravljenih je bilo nekaj fotografij in posnet kratek film. Vlačilec je nadaljeval plovbo, toda po dveh dneh je bilo ugotovljeno, da morskega volka ni več v kletki. Drugi primeri morskih psov, ujetih v tunjih kletkah v Sredozemskem morju, vključujejo dva sinja morska psa, ujeta v kletko med Italijo in Španijo leta 2001, in atlantskega maka, ujetega v kletko med Baleari in Murcio, Španija, leta 2002. Ker ima beli morski volk v Sredozemlju status ranljive vrste, avtorji članka menijo, da bi bilo treba spremljati medsebojne vplive med morskimi psi in tunjimi farmami, predvsem z namenom, da se med poskusi reševanja psov iz tunjih kletk reševalci odločijo za pravi poseg.*

**Ključne besede:** beli morski volk, *Carcharodon carcharias*, tunje farme, Sredozemsko morje

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# SEXUAL DIMORPHISM IN THE SMALL – SPOTTED CATSHARK, *SCYLIORHINUS CANICULA* (L., 1758), FROM THE EDREMIT BAY (TURKEY)

*Zeliha AKA ERDOĞAN, Hatice TORCU KOÇ & Dilek TÜRKER ÇAKIR*
University of Balikesir, Faculty of Science and Arts, D epartment of Biology, TR-10100 Balikesir, Turkey

*Vedrana NERLOVIĆ*
"Ruđer Bošković" Institute, Center for Marine Research, HR-52210 Rovinj, G. Paliaga 5, Croatia

*Jakov DULČIĆ*
Institute of Oceanography and Fisheries, HR-21000 Split, P.O. BOX 500, Croatia
E-mail: dulcic@izor.hr

## *ABSTRACT*

*Morphometric characteristics and dentition of the small-spotted catshark* Scyliorhinus canicula *were analysed. In the year of 1998, 100 individuals were collected by means of trawl hauls from Edremit Bay, northern Aegean Sea. Males have a longer and narrower mouth than females resulting in pronounced sexual dimorphism with respect to the mouth length/mouth width ratio (0.67 and 0.57, respectively). Significant sexual differences in the girth of the head and preoral, prebranchial, head and body lengths were also recorded. Males were found to have longer teeth than females. Reasons for these differences are discussed.*

**Key words**: *Scyliorhinus canicula*, Scyliorhinidae, sexual dimorphism, morphometric characters, Aegean Sea

# DIMORFISMO SESSUALE NEL GATTUCCIO *SCYLIORHINUS CANICULA* (L., 1758) DEL GOLFO DI EDREMIT (TURCHIA)

*SINTESI*

*L'articolo analizza le caratteristiche morfometriche e la dentatura di un centinaio di gattucci* Scyliorhinus canicula, *pescati nel 1998 con la rete a strascico nel Golfo di Edremit (mar Egeo settentrionale). Gli esemplari maschi presentavano una mascella più lunga e sottile delle femmine, a dimostrazione dell'evidente dimorfismo sessuale riscontrabile nel rapporto fra lunghezza e larghezza della mascella stessa (0,67 cm per maschi e 0,57 cm per femmine). Importanti diversificazioni sessuali sono state riscontrate anche nelle dimensioni della testa, nella lunghezza del muso e nella posizione delle branchie, nella lunghezza della testa e del corpo. Nell'articolo, gli autori esaminano i possibili motivi di queste differenze.*

**Parole chiave**: *Scyliorhinus canicula*, Scyliorhinidae, dimorfismo sessuale, caratteristiche morfometriche, mar Egeo

## INTRODUCTION

The small-spotted catshark *Scyliorhinus canicula* (L., 1758) is a benthic species distributed along the Atlantic coasts northward to the Shetlands and southern Norway and in the Mediterranean. It occurs on sandy and muddy bottoms, from shallow waters to about 110 m (around British Isles), up to about 400 m (Mediterranean). It feeds on bottom-living invertebrates (molluscs, crustaceans and small fishes). The species maximum-recorded size is to about 100 cm, usually 75 cm (Fischer *et al.*, 1987; Ellis & Shackley, 1995).

Differences in morphology and dentition are two important characteristics for the taxonomy of elasmobranch fishes. However, intraspecific variation, due to growth, sexual dimorphism and geographical and individual differences, has been poorly studied (Ellis & Shackley, 1995). Brough (1937) correlated changes in the lower jaw structure to sexual maturity and observed that these sexual dimorphic characters were more pronounced in the breeding season and were not present in sexually immature specimens. Jardas (1979) reported that males had longer heads than females, while Ellis & Shackley (1995) noted that males of *S. canicula* possessed a longer and narrower mouth than females, showing a pronounced sexual dimorphism. Kerr (1955) examined some aspects of the teeth in genus *Scyliorhinus*. Totaro *et al*. (1984) made a comparison between teeth and scales of newborn and adult specimens of *S. canicula*. Fischer *et al*. (1987) gave a description of teeth similar to those of previous authors, without mentioning dental formula. Ellis & Shackley (1995) found males to have longer teeth than females. Litvinov (2003) found a clearly pronounced sexual dimorphism in the dental form of small-spotted catshark from West African waters.

The aim of the present study was to determine sexual dimorphism based on head morphometrics and dentition of *S. canicula* from Edremit Bay.

## MATERIAL AND METHODS

In 1998, fish were collected by trawl hauls, from Edremit Bay, northern Aegean Sea, Turkey. Sex, total length (TOT), mouth length (MoL) and mouth width (MoW) (Compagno, 1984) were recorded to the nearest mm, for 25 female and 75 male specimens. Significant differences of the mouth length (% TOT), mouth width (% TOT) and mouth length/mouth width ratio (MoL/MoW) between the sexes were tested by *t*-test of the differences between means (Sokal & Rohlf, 1994; Edmondson & Druce, 1996). The data were divided into two TOT groups (<50 and >50 cm) with similar tests used to determine any significance between two TOT groups within each sex, and between the same TOT groups of each sex.

A representative subsample of fish (25 males and 25 females) was examined for a further six metric measurements of the head region (preoral length, prebranchial length, head length, head girth and anterior teeth height). These dimensions were measured to the nearest mm and converted to % TOT for statistical analysis.

In order to examine the dentition, the jaws were dissected out of 100 specimens. Tooth height was measured by caliper as the distance from cusp tip to the tip of the longest root. Tooth size (% TOT) was used to determine sexual dimorphism (Ellis & Shackley, 1995).

## RESULTS

The mouths of males were significantly longer than of females (3.93 and 3.68%, respectively; $P < 0.05$) and narrower (5.92 and 6.72%, respectively; $P < 0.05$) (Tabs. 1 and 2). These differences resulted in a significant sexual dimorphism with respect to MoL/MoW (0.67 and 0.57 for males and females respectively; $P < 0.05$).

The sexual differences in these metric measurements for each of the size groups (Tab. 3) indicated that sexual dimorphism occurred only in larger TOT groups. The smallest fish sampled (<50 cm) showed no significant differences.

Significant size-based differences were observed for males. MoL/MoW in males increased from 0.62 (<50 cm TOT) to 1.53 (>50 cm TOT) (Tab. 1) with significant differences occurring between fish <50 cm TOT and the larger size group (>50 cm TOT) ($P = 0.001$).

***Tab. 1: Differences in** Scyliorhinus canicula **males in mouth morphometrics by TOT (mean ± standard deviation, and range in parentheses).***
***Tab. 1: Razlike v morfometriji ust pri samcih navadne morske mačke** Scyliorhinus canicula **glede na celotno iztegnjeno dolžino – TOT (srednja vrednost ± standardni odklon ter razpon v oklepaju).***

| Length (cm) | No. | MoL/MoW | MoL(%) | MoW(%) |
|---|---|---|---|---|
| <50 | 65 | 0.62±0.16<br>[0.26-0.95] | 3.83±0.32<br>[2.68-4.28] | 6.28±1.14<br>[4.41-9.8] |
| >50 | 10 | 1.53±0.55<br>[1.05-2.56] | 4.68±0.40<br>[4.39-5.22] | 3.31±0.82<br>[2.04-4.19] |
| ∑ | 75 | 0.67±0.38<br>[0.26-2.56] | 3.93±0.43<br>[2.68-5.22] | 5.92±1.47<br>[2.04-9.8] |

***Tab. 2: Differences for females of small-spotted catshark in mouth morphometrics by TOT (mean ± standard deviation, and range in parentheses).***
***Tab. 2: Razlike v morfometriji ust pri samicah navadne morske mačke glede na celotno iztegnjeno dolžino – TOT (srednja vrednost ± standardni odklon ter razpon v oklepaju).***

| Length (cm) | No. | MoL/MoW | MoL(%) | MoW(%) |
|---|---|---|---|---|
| <50 | 15 | 0.60±0.12 [0.43-0.79] | 3.54±0.52 [2.67-4.38] | 6.34±1.34 [5.13-10.57] |
| >50 | 10 | 0.52±0.07 [0.51-0.70] | 3.99±0.45 [3.53-4.63] | 7.65±0.55 [6.98-8.53] |
| ∑ | 25 | 0.57±0.11 [0.43-0.79] | 3.68±0.53 [2.67-4.63] | 6.72±1.29 [5.13-10.57] |

This difference in MoL/MoW may be the result of an increase in MoL and a relative decrease in MoW as male fish grew. It was shown that MoL of fish <50 cm significantly differed from larger group >50 cm (P <0.001). Significant differences in MoW were shown between <50 cm and >50 cm TOT groups (P <0.001).

Preoral length, prebranchial length, head length, head girth and anterior teeth height were significantly different between males and females (Tab. 4). Females had shorter, wider heads and longer preoral and shorter prebranchial lengths. In the upper jaw, the anterior teeth were large (up to 3 mm in height). The height of the anterior tooth in the upper male jaws increased from 1.0 mm (TOT = 40 cm) to 3.0 mm (TOT = 78.6 cm), whereas the same measurement for females increased from 0.25 mm (TOT = 28.2 cm) to 2.5 mm (TOT = 70.0 cm).

## DISCUSSION

This sexual dimorphism in MoL/MoW was due to an increase in % MoL and decrease in % MoW of males. The changes in mouth morphology may be considered as secondary sexual characteristics. The MoL/MoW values of 0.59 and 0.53 for males and females recorded by Arthur (1950) are similar to those obtained in this study (0.67 and 0.57). The values calculated by Ellis & Sheckley (1995), 0.49 and 0.43 are significantly different from the previously mentioned data.

In the present study, MoL/MoW significantly differed between sexes only for the larger size group and not for specimens <50 cm. It was suggested that changes in mouth morphology were related to sexual maturity (Brough, 1937). It is considered that the changes in mouth morphology of males and the sexual dimorphism in MoL/MoW is related to sexual maturity, since those fish <50 cm were immature. Capapé (1977) noted that the males and females mature at lengths of 40 and 45 cm, respectively, along the Tunisian coast. Capapé *et al.* (1991) stated that males and females mature at lengths of 44 and 41–47 cm, respectively. The same authors also noted that males were larger than females (max. total size were 55 cm for males and 51 cm for females from the Mediterranean coast of France). Ellis & Shackley (1995) suggested that males and females mature at lengths of approximately 52 and 55 cm, respectively. Rodriquez-Cabello *et al.* (1998) reported that females attained first sexual maturity at length of 54.2 cm TOT, while Ivory *et al.* (2002) reported that the length at 50% maturity was 53.5 cm for males (max. TOT = 71.0 cm) and 57.0 cm for females (max. TOT = 70.0 cm).

***Tab. 3: Probability values (P) show the statistical differences of MoL/MoW, MoL and MoW between males and females for the two TOT categories and total sample of small-spotted catshark.***
***Tab. 3: Statistično značilne razlike (P) v MoL/MoW, MoL in MoW med samci in samicami navadne morske mačke pri dveh velikostnih razredih in v skupnem vzorcu.***

| Length (cm) | MoL/MoW | MoL | MoW |
|---|---|---|---|
| <50 | 0.485 | 0.57 | 0.856 |
| >50 | 0.001* | 0.006* | <0.001* |
| ∑ | 0.001* | 0.027* | 0.018* |

*Significant difference/statistično značilna razlika (P <0.05)

During a couple of previous studies carried out along Turkish coasts, Geldiay (1969) and Akşiray (1987) established that maximum length was 80 cm and 150 cm, respectively, while Cihangir *et al.* (1997) noted maximum total lengths of 54.6 cm for males and 51.7 cm for females. The findings of our study are relatively in agreement with the previous assessments. As there have been no similar studies on sexual dimorphism of *S. canicula* in Turkish Seas, a comparison of results could not have been made.

Head girth was significantly greater in females and this confirms the results of Brough (1937) and Ellis & Shackley (1995). Preoral length was significantly shorter in males probably as a result of the increased mouth length. Significant differences in prebranchial length, head length and head girth may indicate sexual differences in the base of growth of the whole head region.

***Tab. 4: Morphometric values (in cm) for six body dimensions (mean ± standard deviation, and range in parentheses) and probability values of differences (P).***
***Tab. 4: Morfometrične vrednosti (v cm) za šest telesnih dimenzij (srednja vrednost ± standardni odklon ter razpon v oklepaju) in statistično značilne razlike (P).***

| Dimension | Males (No. = 25) | Females (No. = 25) | P |
|---|---|---|---|
| Total body length | 557.72±128.99 [284-786] | 477.5±114.83 [246-700] | 0.030* |
| Preoral length | 3.48±0.33 [2.77-4.23] | 3.84±0.66 [3.0-6.50] | 0.020* |
| Prebranchial length | 12.55±1.16 [10.0-14.23] | 11.53±1.70 [8.33-13.65] | 0.024* |
| Head length | 17.38±2.14 [13.70-24.04] | 16.18±1.64 [13.89-20.34] | 0.039* |
| Head girth | 29.18±3.26 [22.00-36.59] | 33.82±3.78 [28.88-47.97] | <0.001* |
| Upper teeth height (anterior) | 0.38±0.11 [0.21-0.60] | 0.29±0.08 [0.17-0.45] | 0.002* |

*Significant difference/statistično značilna razlika (P <0.05)

The results of our study confirm that the teeth of *S. canicula* were larger in males and are therefore in agreement with those of Springer (1979), Ellis & Shackley (1995) and Litvinov (2003). Springer (1979) reported that males often have longer teeth than females, *i.e.* that they are even twice as long as in similarly sized females. In male *S. canicula* from West Africa waters, jaws are larger, stronger, and more calcinated (Litvinov, 2003). The reason for the changes in mouth dimensions in males during maturation and the fact that males have longer teeth than females may be explained by different feeding habits and adaptations for reproductive behaviour. Fedducia & Slaughter (1974) attributed sexual dimorphism in the dentition of the family Rajidae to two different feeding habits. However, McEachran (1977) suggested that no sexual differentiation in food exists and that sexually dimorphic dentition may be an adaptation to the reproductive behaviour. In this study, the food of *S. canicula* is composed primarily of crustaceans and small fishes. It has been reported that the small-spotted catshark feeds on decapod crustaceans, molluscs and teleosts (Lyle, 1983; Ellis & Shackley, 1995; Olasa *et al.*, 1998). Lyle (1983) found a significant sexual difference in the diet of small-spotted catshark in Isle of Man waters. Kabasakal (2001) reported that the diet of *S. canicula* is composed of fishes, crustaceans, cephalopods, but that no sexual differences were found in feeding habits.

# SPOLNI DIMORFIZEM NAVADNE MORSKE MAČKE *SCYLIORHINUS CANICULA* (L., 1758) IZ EDREMITSKEGA ZALIVA (TURČIJA)

*Zeliha AKA ERDOĞAN, Hatice TORCU KOÇ & Dilek TÜRKER ÇAKIR*
University of Balikesir, Faculty of Science and Arts, Department of Biology, TR-10100 Balikesir, Turkey

*Vedrana NERLOVIĆ*
"Ruđer Bošković" Institute, Center for Marine Research, HR-52210 Rovinj, G. Paliaga 5, Croatia

*Jakov DULČIĆ*
Institute of Oceanography and Fisheries, HR-21000 Split, P.O. BOX 500, Croatia
E-mail: dulcic@izor.hr

*POVZETEK*

*V prispevku so analizirane morfometrične značilnosti in zobovje stotih navadnih morskih mačk* Scyliorhinus canicula*, ujetih leta 1998 z vlečno mrežo v Edremitskem zalivu (severno Egejsko morje). Ugotovljeno je bilo, da imajo samci daljšo in ožjo čeljust kot samice, kar kaže na izrazit spolni dimorfizem v razmerju dolžine/širine čeljusti (0,67 oz. 0,57 cm). Pomembne spolne razlike so bile zabeležene tudi v obsegu glave, predustnih in predškržnih dolžinah ter dolžinah glave in telesa. Avtorji v članku razpravljajo o možnih vzrokih za te razlike.*

**Ključne besede**: *Scyliorhinus canicula*, Scyliorhinidae, spolni dimorfizem, morfometrične značilnosti, Egejsko morje

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# SHARKS CAPTURED BY COMMERCIAL FISHING VESSELS OFF THE COAST OF TURKEY IN THE NORTHERN AEGEAN SEA

*Hakan KABASAKAL & Elif KABASAKAL*

Ichthyological Research Society, Atatürk Mahallesi, Menteşo ğlu Caddesi, İdil Apt., No: 30, D: 4, Ümraniye TR-34764 İstanbul, Turkey
E-mail: hakankabasakal@hotmail.com

## *ABSTRACT*

*Between 1995 and 2004, 1068 sharks – representing 20 species, 11 families and 5 orders – were recorded off the coast of NE Aegean Sea. 1003 (93.8%) of them were captured by means of bottom trawling, followed by long-lining (n = 30, 2.8%), gill-netting (n = 25, 2.34%), purse-seining (n = 5, 0.46%) and hand-lining (n = 1, 0.09%), while the remaining 4 sharks (0.37%) were sighted by a diver* (Carcharodon carcharias, *TOT ca. 500 cm) or by fishermen. Juveniles of* Galeus melastomus, Scyliorhinus canicula, Etmopterus spinax, Squalus acanthias *and* S. blainvillei *dominated the by-catch of bottom trawlers operating in the investigated area.*

**Key words**: sharks, fishery, Turkey, NE Aegean Sea, by-catch

## SQUALI CATTURATI NELLE ACQUE TURCHE DEL MAR EGEO SETTENTRIONALE

*SINTESI*

*Tra il 1995 ed il 2004, nelle acque turche del Mar Egeo settentrionale sono stati registrati 1068 squali, appartenenti a 20 specie, 11 famiglie e 5 ordini. Ben 1003 esemplari (93,8%) sono stati catturati con la coccia (rete a strascico), 30 (2,8%) con il parangale (lenza armata con numerosi ami), 25 (2,34%) con il tramaglio (rete da posta), 5 squali (0,46%) con la saccaleva (rete da circuizione), un esemplare (0,09%) con la classica lenza a mano, mentre i restanti 4 (0,37%) sono stati segnalati da un subacqueo* (Carcharodon carcharias, *TOT ca. 500 cm) e da pescatori. Tra le catture casuali con le coccie nell'area in questione c'era una prevalenza di giovani esemplari delle specie* Galeus melastomus, Scyliorhinus canicula, Etmopterus spinax, Squalus acanthias *and* S. blainvillei.

**Parole chiave**: squali, pesca, Turchia, Mar Egeo settentrionale, pesca casuale

## INTRODUCTION

According to the more recent list of elasmobranch species from the seas of Turkey (Kabasakal, 2002a), a total of 28 confirmed species of sharks have been recorded from the Turkish coast of Aegean Sea to date. However, our knowledge about the distribution, bio-ecological features and population structures of nearly all of these 28 species, even of the commercially exploited ones, still include significant gaps, and this circumstance causes remarkable difficulties in terms to regulate their fisheries or conservation. As previously reported, the amount of by-caught sharks, especially by the Turkish trawling fleet operating in the northern Aegean Sea, is quite high (Kabasakal, 1998). On the other hand, littoral and bathyal grounds of the northern Aegean Sea, mainly along the eastern side, are important nurseries and breeding areas for many shark species (D'Onghia *et al.*, 1995; Kabasakal, 2002a). Investigations of the interactions between sharks and fishing operations in the northern Aegean Sea are therefore of vital importance.

There are very few recent reports on sharks known to have occurred along the coast of Turkey in the northern Aegean Sea, and the knowledge of sharks from the mentioned area is mainly limited either to the general ichthyological works, which have been carried out by Turkish or foreign researchers (see for example, Whitehead *et al.* 1984; Akşıray, 1987; Ulutürk, 1987; Keskin & Ünsal, 1998), or works on the systematics or biology of a few species of sharks captured in this area (D'Onghia *et al.*, 1995; Cihangir *et al.*, 1997; Kabasakal & Ünsal, 1999; Kabasakal, 2002a, b, c; Kabasakal & Kabasakal, 2002).

The aim of the present study is to provide information on the presence and bio-ecological features of shark species captured by commercial fishing vessels along the Turkish coast in the northern Aegean Sea between 1995 and 2004.

## MATERIAL AND METHODS

The study area is the northeastern part of the Aegean Sea (Fig. 1), characterized by an extended continental shelf, lower salinities due to the Pontic fresh water going through the Dardanelles, absence of thermophile fauna, and practically unchanged water temperature throughout the year below 250 m (13.5 º to 14.0 ºC) (Kocataş & Bilecik, 1992; Papaconstantinou, 1992).

Samplings of sharks were carried out mainly on board of commercial fishing trawlers by means of a bottom trawl with a cod-end mesh opening of 22 mm from knot to knot. Furthermore, shark by-catches with the aid of purse-seines, gill-netters, bottom long-liners and swordfish harpooners were also analysed. Whenever possible, the following data were recorded: total length (TOT) of shark to the nearest cm, sex and sampling locality. Total length (TOT) of the shark is the distance between the tip of the nose and the tip of the upper lobe of the caudal fin, lay in natural position (Compagno, 1984a). One to three specimens of the following species were fixed and preserved in 5% formaline solution in sea water (now kept at the Faculty of Fisheries, University of Istanbul): *Hexanchus griseus* (Bonnaterre, 1788), bluntnose sixgill shark; *Galeus melastomus* Rafinesque, 1810, blackmouth catshark; *Scyliorhinus canicula* (Linnaeus, 1758), small-spotted catshark; *Scyliorhinus stellaris* (Linnaeus, 1758), nursehound; *Galeorhinus galeus* (Linnaeus, 1758), tope shark; *Mustelus asterias* Cloquet, 1821, starry smoothhound; *Mustelus mustelus* (Linnaeus, 1758), smoothhound; *Oxynotus centrina* (Linnaeus, 1758), angular roughshark; *Etmopterus spinax* (Linnaeus, 1758), velvet belly; *Dalatias licha* (Bonnaterre, 1788), kitefin shark; *Squalus acanthias* Linnaeus, 1758, spiny dogfish; *Squalus blainvillei* (Risso, 1827), longnose spurdog; *Squatina oculata* Bonaparte, 1840, smoothback angelshark; and *Squatina squatina* (Linnaeus, 1758), angelshark. Our study also included the taxidermied specimens of blue shark, *Prionace glauca* (Linnaeus, 1758), and smooth hammerhead, *Sphyrna zygaena* (Linnaeus, 1758), preserved in the collection of Gökçeada Marine Station (GMS), Çanakkale, Turkey. No specimens of the great white shark, *Carcharodon carcharias* (Linnaeus, 1758), porbeagle, *Lamna nasus* (Bonnaterre, 1788), basking shark, *Cetorhinus maximus*

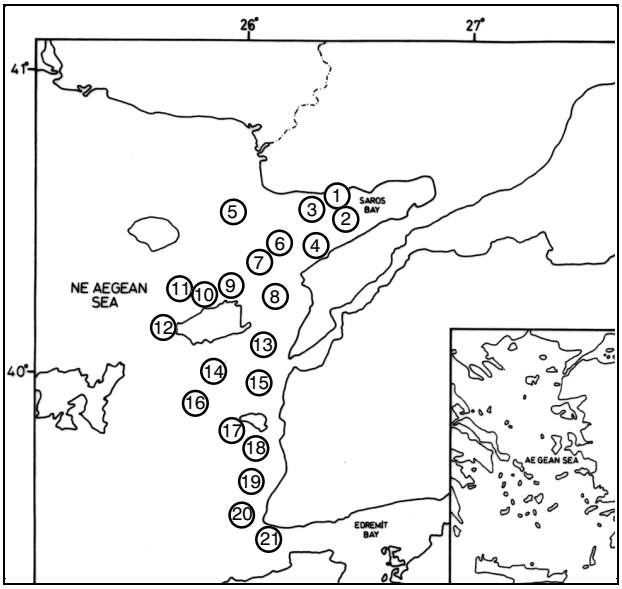


***Fig. 1: Map showing the investigated area in NE Aegean Sea. Circled numbers indicate approximate locality of the stations.***
***Sl. 1: Zemljevid raziskovalnega območja v severovzhodnem Egejskem morju. Obkrožene številke ponazarjajo približne lokalitete postaj.***

***Fig. 2: Lateral view of the head of female*** *A. vulpinus* ***(400 cm TOT). (Photo: H. Kabasakal)***
***Sl. 2: Pogled od strani na glavo samice*** *A. vulpinus* ***(400 cm TOT). (Foto: H. Kabasakal)***

(Gunnerus, 1765) or thresher shark, *Alopias vulpinus* (Bonnaterre, 1788), are available in the collections of Gökçeada Marine Station or Faculty of Fisheries, University of Istanbul, as large sharks are generally sold at fish markets (only teeth samples are available for a female specimen of *A. vulpinus*, TOT 400 cm; see Table 1). Identification follows Compagno (1984a, b). Taxonomic nomenclature follows the check-list proposed by the European Register of Marine Species (http: //erms.biol.soton.ac.uk./lists/brief/Chondrichthyes.shtml).

## RESULTS

Between 1995 and 2004, we recorded 1068 sharks, representing 20 species, 11 families, and 5 orders. These were: order Hexanchiformes: *H. griseus* (Bonnaterre, 1788) (n = 7) (family Hexanchidae); order Lamniformes: *C. carcharias* (Linnaeus, 1758) (n = 3), *L. nasus* (Bonnaterre, 1788) (n = 1) (family Lamnidae); *C. maximus* (Gunnerus, 1765) (n = 1) (family Cetorhinidae); *A. vulpinus* (Bonnaterre, 1788) (n = 3) (family Alopiidae); order Carcharhiniformes: *G. melastomus* Rafinesque, 1810 (n = 183), *S. canicula* (Linnaeus, 1758) (n = 119), *S. stellaris* (Linnaeus, 1758) (n = 3) (family Scyliorhinidae); *G. galeus* (Linnaeus, 1758) (n = 2), *M. asterias* Cloquet, 1821 (n = 14), *M. mustelus* (Linnaeus, 1758) (n = 30) (family Triakidae); *P. glauca* (Linnaeus, 1758) (n = 3) (family Carcharhinidae); *S. zygaena* (Linnaeus, 1758) (n = 1) (family Sphyrnidae); order Squaliformes: *E. spinax* (Linnaeus, 1758) (n = 220), *O. centrina* (Linnaeus, 1758) (n = 1), *D. licha* (Bonnaterre, 1788) (n = 5) (family Dalatiidae); *S. acanthias* Linnaeus, 1758 (n = 447), *S. blainvillei* (Risso, 1827) (n = 18) (family Squalidae); and order Squatiniformes: *S. oculata* Bonaparte, 1840 (n = 2), *S. squatina* (Linnaeus, 1758) (n = 5) (family Squatinidae).

***Fig. 3: A pregnant female of*** *M. asterias* ***(153 cm TOT) had 21 embryos in its uterus. (Photo: H. Kabasakal)***
***Sl. 3: V maternici breje samice vrste*** *M. asterias* ***(153 cm TOT) je bilo odkritih 21 zarodkov. (Foto: H. Kabasakal)***

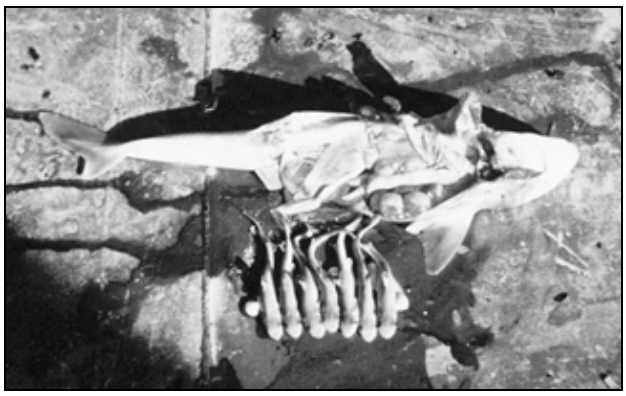

***Fig. 4: A pregnant female of*** *S. blainvillei* ***(84 cm TOT) had 7 embryos in its uterus. (Photo: H. Kabasakal)***
***Sl. 4: V maternici breje samice vrste*** *S. blainvillei* ***(84 cm TOT) je bilo odkritih 7 zarodkov. (Foto: H. Kabasakal)***

Of the 1068 sharks recorded, 1003 (93.8%) had been captured by means of bottom trawling, followed by long-lining (n = 30, 2.8%), gill-netting (n = 25, 2.34%), purse-seining (n = 5, 0.46%) and hand-lining (n = 1, 0.09%), while the remaining 4 sharks (0.37%) were sighted by a diver (*C. carcharias*, TOT ca. 500 cm, Tab. 1) or by fishermen.

The data collected are presented in Table 1. The number of sharks captured off the Turkish coast in the northern Aegean Sea between 1995 and 2004 and the percentage of each species of the total shark captures are presented in Table 2.

***Tab. 1: Sharks captured or sighted by commercial fishing vessels off the Turkish coast of NE Aegean Sea. Station numbers in the table are the same as circled numbers in figure 1.***
***Tab. 1: Morski psi, ki so jih v turških vodah severovzhodnega Egejskega morja ujele ali opazile posadke ribiških bark. Oštevilčene postaje v tabeli so enake obkroženim številkam na sliki 1.***

| SPECIES | No. | DATE | STATIONS | SEX | TOTAL LENGTH (cm) | NOTES |
|---|---|---|---|---|---|---|
| *Hexanchus griseus* | 1 | 1997 | 10 | ? | 350 | Captured at a depth of 400 m by means of bottom trawling. |
| | 1 | 1998 | 13 | M | 360 | Captured by bottom trawl. |
| | 1 | 20 Jul 1998 | 11 | M | 400 | Captured by bottom trawl. Claspers were fully calcified. |
| | 1 | Oct 1999 | 3 | F | 66 | Captured by bottom trawl. An unhealed umbilical scar was noticed on its ventral surface. |
| | 1 | 6 Jul 2000 | 11 | ? | 400 | Captured by purse-seining. |
| | 1 | 24 Aug 2002 | 3 | F | 400 | - |
| | 1 | 25 Dec 2002 | 21 | ? | ? | A very large specimen weighing nearly 565 kg (R. Çavuş, *pers. comm.*). |
| *Carcharodon carcharias* | 1 | Mar 1996 | 17 | F | 550 | Captured by purse-seining. |
| | 1 | Apr 1998 | 16 | ? | ca. 450 | Sighted by a gill-netter. |
| | 1 | May 1999 | 4 | ? | ca 500 | Sighted by a diver. |
| *Lamna nasus* | 1 | 11 Apr 2004 | 18 | M | 250 | Captured by fishermen A. Gürtay *(pers. comm.)* by means of gill-netting. |
| *Cetorhinus maximus* | 1 | 16 May 1997 | 14 | ? | ca. 800 | Sighted by a swordfish harpooner. |
| *Alopias vulpinus* | 1 | Jun 1996 | 14 | F | 400 | Captured by a tuna hand-liner (Fig. 2). |
| | 1 | Jul 1996 | 20 | F | 600 | Captured by purse-seining. |
| | 1 | 3 Apr 2004 | 19 | M | 250 | Captured by gill-netting in coastal waters. |
| *Galeus melastomus* | 20 | Jul 1997 | 9 | M | 16-25 | Captured by bottom trawling. |
| | 17 | Jul 1997 | 9 | F | 15.2-27 | Captured by bottom trawling. |
| | 63 | Oct 1999 | 10 | M | 18.22 | Captured by bottom trawling. |
| | 83 | Oct 1999 | 10 | F | 14-29.3 | Captured by bottom trawling. |
| *Scyliorhinus canicula* | 8 | Jul 1997 | 12 | M | 32-45 | Captured by long-lining. |
| | 6 | Jul 1997 | 12 | F | 26-50.2 | Captured by long-lining. Specimens ≥ 40 cm TOT contained egg cases. |
| | 65 | Mar 1998 | 5 | M | 15-45.2 | Captured by bottom trawling. |
| | 40 | Mar 1998 | 5 | F | 17-50 | Captured by bottom trawling. Specimens ≥ 40 cm TOT contained egg cases. |
| *Scyliorhinus stellaris* | 3 | Mar 1997 | 18 | F | 40-165 | Captured by bottom trawling. Two females, 155 and 165 cm TOT, contained egg cases (one in each uterus). |
| *Galeorhinus galeus* | 1 | Sep 1997 | 8 | M | 165 | Captured by bottom trawling. Claspers were fully calcified. |
| | 1 | Oct 1997 | 15 | M | 175 | Captured by bottom trawling. Claspers were fully calcified. |
| *Mustelus asterias* | 5 | Mar 1997 | 3 | F | 45-95 | Captured by gill-netting. Specimen, 95 cm TOT, contained matured eggs. |
| | 2 | Sep 1997 | 2 | F | 75-104 | Captured by bottom trawling. |
| | 6 | Sep 1997 | 2 | M | 45-112 | Captured by bottom trawling. |
| | 1 | Nov 1997 | 2 | F | 153 | Captured by bottom trawling. A total of 21 embryos were found in the uterus (Fig. 3). |
| *Mustelus mustelus* | 10 | Oct 1997 | 6 | M | 40-109 | Captured by otter trawling. Claspers of the specimens ≥ 70 cm TOT were fully calcified. |
| | 6 | Oct 1997 | 6 | F | 53-130 | Captured by bottom trawling. Specimens ≥ ca. 75 cm TOT contained matured eggs. |
| | 5 | Sep 1998 | 7 | M | 90-122 | Captured by long-lining. |
| | 7 | Sep 1998 | 7 | F | 83-132 | Captured by long-lining. |
| | 2 | Mar 1999 | 20 | M | 43-52 | Captured by bottom trawling. |
| *Prionace glauca* | 1 | May 1997 | 9 | M | 220 | Captured by purse-seining. Head and caudal fin are preserved in the field museum of GMS. |
| | 1 | Jun 1997 | 10 | F | 51 | Captured by seining. Specimen is preserved in the museum of GMS. |
| | 1 | Oct 1999 | 9 | ? | ca. 250 | Sighted on board of fishing trawler Şekerbaba 2, while attacking the cod-end. |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Sphyrna zygaena* | 1 | Jun 1998 | 12 | F | 221 | Captured by gill-netting. Head and caudal fin are preserved in the field museum of GMS. |
| *Etmopterus spinax* | 5 | 16 Oct 1996 | 2 | 3 F, 2 M | 15.3-20.4 | Captured by bottom trawling at a depth of 280 m. Males were 186 and 204 mm TOT, females 153 to 197 mm TOT. Morphometric and biological data on the examined specimens are given by Kabasakal & Ünsal (1999). |
| | 122 | Oct 1999 | 9,10,11 | M | 12-21 | Captured by bottom trawling. |
| | 93 | Oct 1999 | 9,10,11 | F | 14-22.7 | Captured by bottom trawling. |
| *Oxynotus centrina* | 1 | Nov 1998 | 16 | F | 65 | Captured by bottom trawling. |
| *Dalatias licha* | 5 | Octr 1999 | 9 | M | 33.8-41.9 | Captured by bottom trawling at a depth of 380 m. Three specimens were found to bear healing umbilical scar. Morphometric and biological data on the examined specimens are given by Kabasakal & Kabasakal (2002). |
| *Squalus acanthias* | 65 | 1-3 Mar 1997 | 13, 14, 15, 16, 18, 20 | M | 35-87 | Captured by bottom trawling. |
| | 47 | 1-3 Mar 1997 | 13, 14, 15, 16, 18, 20 | F | 37-103 | Captured by bottom trawling. |
| | 9 | Jul 1997 | 8 | M | 40-75 | Captured by gill-netting. |
| | 6 | Jul 1997 | 8 | F | 50-65 | Captured by gill-netting. |
| | 128 | Sep - Nov 1997 | 4, 7, 9, 14, 16, 19, 21 | M | 47-98 | Captured by bottom trawling. |
| | 137 | Sep - Nov 1997 | 4, 7, 9, 14, 16, 19, 21 | F | 37-103 | Captured by bottom trawling. |
| | 35 | Oct 1999 | 7, 9, 10 | M | 30-37 | Captured by bottom trawling. |
| | 20 | Oct 1999 | 7, 9, 10 | F | 28-32 | Captured by bottom trawling. |
| *Squalus blainvillei* | 10 | Oct 1996 | 3 | M | 30-51 | Captured by bottom trawling. |
| | 8 | Oct 1996 | 3 | F | 35-87 | Captured by bottom trawling. One of the specimens, 87 cm TOT, was found to contain 7 embryos in the uterus (Fig. 4). |
| *Squatina oculata* | 1 | Jul 1997 | 8 | M | 30 | Captured by bottom trawling. |
| | 1 | Sep 1999 | 13 | F | 95 | Captured by bottom trawling. |
| *Squatina squatina* | 3 | Oct 1996 | 13 | M | 120-152 | Captured by long-lining. |
| | 2 | Jul 1997 | 12 | M | 75-83 | Captured by gill-netting. |

## DISCUSSION AND CONCLUSIONS

Twenty shark species captured during the study constitute 71.42% of the total shark fauna, recorded from the Turkish Aegean Sea to date (Kabasakal, 2002a). In terms of the number of captured individuals, *S. acanthias* (n = 447, 41.85%) was the most abundant species, followed by *E. spinax* (n = 220, 20.59%), *G. melastomus* (n = 183, 17.13%) and *S. canicula* (n = 119, 11.14%). The number of the captured individuals of the remaining species was less than 30, and only individual each of *L. nasus*, *C. maximus*, *S. zygaena* and *O. centrina* were captured over the 9-year investigation period.

Before the present study, *H. griseus*, a new-born female of 66 cm TOT was recorded from the bathyal grounds off the northern coast of Gökçeada by Kabasakal (2002a). Mature individuals of the bluntnose six-gill shark were recorded for the first time off the coast of Turkey in the northern Aegean Sea during the present study. The scarcity of capture records of the great white shark and porbeagle in Turkish waters is obvious, and only one report dealing with the occurrence of *C. carcharias* in the Sea of Marmara is available (Kabasakal, 2003). During the present study, we recorded 3 great white sharks in the investigated area between 1996 and 1999. *C. carcharias* was recorded for the first time in the investigated area. Only one *L. nasus* was recorded in 2004, and this is the second porbeagle record off the Turkish coast of the Aegean Sea (Kabasakal, 2002a). The presence of the basking shark in Turkish waters has always been a point of discussion. According to Kıdeyş (1997) and Kabasakal (2002d), the basking shark encounters in Turkish waters are concentrated off the southern coast of Anatolian peninsula, and it has been therefore for long time assumed that the distribution range of *C. maximus* does not extend to the northern Aegean Sea. The sighting of a basking shark of ca. 8 m TOT suggests, however, that this filter-feeding shark may penetrate the mentioned area. But based on a single sighting, it is not possible to say whether the basking shark occurrence in the northern Aegean Sea shows seasonal regularity. The occurrence of *H. griseus*, *C. carcharias*, *L. nasus* and *C. maximus* in northern Aegean Sea has been reported by Papaconstantinou (1988), but the fact is that his results are based on the old work of Konsuloff & Drenski (1943; cited in Papaconstantinou & Tsimenidis, 1979). In the recent study carried out by Fergusson (1996), its author reports on the occurrence of

***Tab. 2: Number of recorded specimens of each shark species.***
***Tab. 2: Število zabeleženih primerkov posameznih vrst morskih psov.***

| SPECIES | No. | % |
|---|---|---|
| *Hexanchus griseus* (Bonnaterre, 1788) | 7 | 0.65 |
| *Carcharodon carcharias* (Linnaeus, 1758) | 3 | 0.28 |
| *Lamna nasus* (Bonnaterre, 1788) | 1 | 0.09 |
| *Cetorhinus maximus* (Gunnerus 1765) | 1 | 0.09 |
| *Alopias vulpinus* (Bonnaterre, 1788) | 3 | 0.28 |
| *Galeus melastomus* Rafinesque, 1810 | 183 | 17.13 |
| *Scyliorhinus canicula* (Linnaeus, 1758) | 119 | 11.14 |
| *S. stellaris* (Linnaeus, 1758) | 3 | 0.28 |
| *Galeorhinus galeus* (Linnaeus, 1758) | 2 | 0.18 |
| *Mustelus asterias* Cloquet, 1821 | 14 | 1.31 |
| *M. mustelus* (Linnaeus, 1758) | 30 | 2.8 |
| *Prionace glauca* (Linnaeus, 1758) | 3 | 0.28 |
| *Sphyrna zygaena* (Linnaeus, 1758) | 1 | 0.09 |
| *Etmopterus spinax* (Linnaeus, 1758) | 220 | 20.59 |
| *Oxynotus centrina* (Linnaeus, 1758) | 1 | 0.09 |
| *Dalatias licha* (Bonnaterre, 1788) | 5 | 0.46 |
| *Squalus acanthias* Linnaeus, 1758 | 447 | 41.85 |
| *S. blainvillei* (Risso, 1827) | 18 | 1.68 |
| *Squatina oculata* Bonaparte, 1840 | 2 | 0.18 |
| *S. squatina* (Linnaeus, 1758) | 5 | 0.46 |

4 great white sharks in northern Aegean waters. Before the present study, Ulutürk (1987) reported on single captures of *P. glauca* and *S. zygaena* off the coast of Gökçeada (NE Aegean Sea). The common thresher shark, *A. vulpinus*, has been recorded for the first time in the investigated area. Therefore, our study provides updated information on the occurrence of these large sharks from the investigated area.

*G. melastomus*, *S. canicula*, *S. stellaris*, *M. asterias*, *M. mustelus*, *E. spinax*, *S. acanthias*, *S. blainvillei* and *S. squatina* are considered as quite to very common species in the northern Aegean Sea by some researchers (Papaconstantinou & Tsimenidis, 1979; Papaconstantinou & Tortonese, 1980; Ulutürk, 1987; Keskin & Ünsal, 1998; Kabasakal, 2002a). On the other hand, *G. galeus*, *O. centrina*, *D. licha* and *S. oculata* are considered as rare in the same area (Papaconstantinou & Tortonese, 1980; Whitehead *et al.*, 1984; Kabasakal, 2002a; Kabasakal & Kabasakal, 2002). The number of the captured specimens of these 4 sharks over the 9 year research period confirms their rarity in the investigated area (Tab. 1).

The total lengths of nearly all sharks fell within the ranges previously described for these species by Compagno (1984a, b). However, in two cases total lengths of the specimens exceeded the reported maximum values (Tab. 3). One of the pregnant female *S. stellaris* captured in March 1997 and measured as 165 cm TOT by one of the authors (H. Kabasakal), exceeds the reported maximum TOT for this species (162 cm in Compagno, 1984b). In the second case, a pregnant female *M. asterias* captured in November 1997 and measured by H. Kabasakal as 153 cm TOT, also exceeds the reported maximum TOT for this species (140 cm in Compagno, 1984b).

During the present study, significant numbers of new-born and juvenile sharks as well as pregnant females were captured at most of the stations. The newborn *H. griseus* of 66 cm TOT, captured in October 1999, bore an umbilical scar. According to Capapé *et al.* (2004), size at birth of *H. griseus* from the Mediterranean Sea ranged between 55.6 and 68 cm TOT. Significant numbers of *G. melastomus* new-hatchlings and juveniles were captured. According to Compagno (1984b), the minimum TOT of mature male and female blackmouth catsharks is 34 cm and 39 cm, respectively. *S. canicula* is another catshark, whose new-hatchlings and juveniles were captured in significant numbers, and according to Compagno (1984b) the size at hatching of this species is 9 to 10 cm. Barrull & Mate (2002) reported the size at hatching of *S. canicula* as 7 cm. The smallest individual of *S. canicula* during the present research is 15 cm TOT. Size at birth of *M. asterias* is 28.5 to 30 cm (Quignard & Capapé, 1972) and of *M. mustelus* is 39 cm (Capapé, 1974). The smallest individual of the former triakid shark is 45 cm TOT and 40 cm for the latter. Although we did not observe any umbilical scar on these juveniles, their total lengths are very close to size at birth. In June 1997, a female blue shark, *P. glauca*, of 51 cm TOT was captured by seining and is now preserved in the GMS as a

***Tab. 3: Recorded and maximum TOT range of each shark species.***
***Tab. 3: Razpon izmerjenih in maksimalnih celotnih iztegnjenih dolžin (TOT) posameznih vrst morskih psov.***

| SPECIES | Recorded TOT range (cm) | Max. TOT (cm) (Compagno 1984a, b) |
|---|---|---|
| *Hexanchus griseus* (Bonnaterre, 1788) | 66-400 | 482 |
| *Carcharodon carcharias* (Linnaeus, 1758) | ca. 450-550 | 640 |
| *Lamna nasus* (Bonnaterre, 1788) | 250 | 300 |
| *Cetorhinus maximus* (Gunnerus 1765) | ca. 800 | 1520 |
| *Alopias vulpinus* (Bonnaterre, 1788) | 250-600 | 610 |
| *Galeus melastomus* Rafinesque, 1810 | 15.2-29.3 | 90 |
| *Scyliorhinus canicula* (Linnaeus, 1758) | 15-50.2 | 60 |
| *S. stellaris* (Linnaeus, 1758) | 40-165 | 162 |
| *Galeorhinus galeus* (Linnaeus, 1758) | 165-175 | 195 |
| *Mustelus asterias* Cloquet, 1821 | 45-153 | 140 |
| *M. mustelus* (Linnaeus, 1758) | 40-132 | 164 |
| *Prionace glauca* (Linnaeus, 1758) | 97-ca. 250 | 383 |
| *Sphyrna zygaena* (Linnaeus, 1758) | 221 | 400 |
| *Etmopterus spinax* (Linnaeus, 1758) | 11-22.7 | 60 |
| *Oxynotus centrina* (Linnaeus, 1758) | 65 | 150 |
| *Dalatias licha* (Bonnaterre, 1788) | 33.8-41.9 | 182 |
| *Squalus acanthias* Linnaeus, 1758 | 28-103 | 160 |
| *S. blainvillei* (Risso, 1827) | 30-87 | 95 |
| *Squatina oculata* Bonaparte, 1840 | 30-95 | 160 |
| *S. squatina* (Linnaeus, 1758) | 75-152 | 244 |

taxidermied specimen. Regarding the size at birth of the blue shark, 35 to 44 cm TOT (Compagno, 1984b), it is possible to classify this specimen as a neonate, and this is the first neonate blue shark reported off the Turkish coast of the northern Aegean Sea. The smallest individual of *E. spinax* captured during the present study is 12 cm TOT, while the largest is 22.7 cm TOT. Specimens between 12 to 15 cm TOT bore healing umbilical scar; Vacchi & Relini Orsi (1979), Bauchot (1987), Barrull *et al*. (1999) and De Maddalena & Piscitelli (2001) reported that size at birth of the velvet belly is 10 to 11 cm TOT. Three specimens of *D. licha*, 33.8 to 37.2 cm TOT, bore healing umbilical scars (Kabasakal & Kabasakal, 2002). According to Compagno (1984a), the size of the kitefin shark at birth is about 30 cm. Total lengths of the captured specimens of *S. acanthias* and *S. blainvillei* ranged between 28 to 103 cm TOT, and 30 to 87 cm TOT, respectively. Individuals of *S. acanthias* between 28 to 35 cm TOT bore umbilical scars, and the size at birth of the piked dogfish is 22 to 33 cm (Compagno, 1984a). Although we did not observe any birth mark on the smallest individual (30 cm TOT) of *S. blainvillei*, its size is very close to the size at birth (about 23 cm TOT) of the species (Compagno, 1984a). With the exception of male *S. oculata* of 30 cm TOT, captured in July 1997, total length of the remaining individuals of both squatinid sharks were well above the size at birth described for two species (24 to 27 cm TOT for *S. oculata*, and 24 to 30 cm TOT for *S. squatina*; Compagno, 1984a).

Some pregnant sharks were also captured during the present study. Females of *S. canicula*, ≥ 40 cm TOT, contained egg cases in uteri; these specimens were captured in both littoral and bathyal haulings. Two female *S. stellaris*, 155 and 165 cm TOT, captured at a depth of 70 m, contained egg cases in uteri. Female *M. asterias* of 153 cm TOT, captured in November 1997 at a depth of nearly 150 m, had 21 embryos in its uterus. Females of *M. asterias*, ≥ 95 cm TOT, and *M. mustelus*, ≥ ca. 75 cm TOT, contained matured ova. Seven embryos were found in the uterus of a female *S. blainvillei* of 87 cm TOT, captured in October 1996 at a depth of 170 m.

The recorded data is not sufficient to make clear judgements on the reproductive biology and breeding seasons of sharks in the northern Aegean Sea; however, they provide us with some useful information, indicating the presence of breeding and nursery grounds of sharks in littoral and bathyal zones. Based on research, concerning the depth distribution of *S. canicula* in the northern Aegean Sea, D'Onghia *et al*. (1995) concluded that spawning and birth of the new generation of the lesser-spotted catshark might occur in the bathyal grounds of the mentioned area. In a previous study, Kabasakal (2002a) reported on the presence of suitable breeding and nursery grounds of bathyal sharks, rays and the holocephalan, *Chimaera monstrosa* along the Turkish coast of NE Aegean Sea. Needless to say, extensive investigations are required for mapping such

breeding and nursery grounds, and estimating the impacts of bottom trawling on these habitats.

Of 1068 sharks recorded, 1003 specimens (93.91%) were captured by bottom trawling. In the NE Aegean Sea, bottom trawling on the continental shelf and slope from about 200 m to 600 m depth targeting decapod crustaceans with high economic value, such as *Parapenaeus longirostris*, *Nephrops norvegicus*, and the European hake, *Merluccius merluccius*, is important fishery. However, besides the targeted species, sharks and other elasmobranchs are the main by-catch of bottom trawlers operating in the investigated area. With the exception of large specimens of carcharhiniforms, squaliforms and squatinids, sharks are generally discarded. In the present study, juveniles of *G. melastomus*, *S. canicula*, *E. spinax*, *S. acanthias* and *S. blainvillei* dominated the by-catch. Sartor *et al*. (2003) reported that in bottom trawling discard was particularly frequent in cases of low commercial value species, such as blackmouth catshark, *G. melastomus*, which is one of the main by-catches recorded during the present study. According to Sartor *et al*. (2003), this kind of fishery produces a significant amount of discard, reaching about 20% of the total catch on different fishing grounds.

The study of sharks from commercial fisheries allows us to monitor the state of local shark populations. Furthermore, a continuous long-term analysis of commercial fisheries may provide information on the occurrence and fisheries status of sharks present in the investigated area. The present study has been performed without any support from public institutions, and for this very reason the results show some incompleteness and approximations. However, it may be considered as a pioneering attempt to provide a data base for future researches on shark populations to be conducted in the investigated area. Ecologically, sharks are *'k-selected'* species having long sexual maturation times, low fecundity, long gestation periods and relatively small litter size, which makes them extremely vulnerable to fishing pressures. There is a critical need for biological information on the life history of many shark species in order to better assess the stock status and the impact of fisheries. Lack of research and conservation of sharks in many countries, such as is sadly the case in Turkey, may lead to the extinction of many shark species in the future.

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# MORSKI PSI, UJETI V TURŠKIH VODAH SEVERNEGA EGEJSKEGA MORJA

*Hakan KABASAKAL & Elif KABASAKAL*

Ichthyological Research Society, Atatürk Mahallesi, Menteşo ğlu Caddesi, İdil Apt., No: 30, D: 4, Ümraniye TR-34764 İstanbul, Turkey
E-mail: hakankabasakal@hotmail.com

*POVZETEK*

*Med letoma 1995 in 2004 je bilo v turških vodah severovzhodnega Egejskega morja zabeleženih 1068 morskih psov, pripadajočih 20 vrstam, 11 družinam in 5 redom. Kar 1003 (93,8%) od teh psov je bilo ujetih s kočami, 30 (2,8%) s parangali, 25 (2,34%) s stoječimi mrežami, 5 (0,46%) s povlečnimi mrežami in 1 (0,09%) ročno na trnek, medtem ko so preostale 4 (0,37%) opazili potapljači* (Carcharodon carcharias, *TOT cca. 500 cm) ali ribiči. V naključnih ulovih s kočami bark, ki so lovile v raziskovalnem območju, so prevladovali mladostni osebki vrst* Galeus melastomus, Scyliorhinus canicula, Etmopterus spinax, Squalus acanthias *in* S. blainvillei.

**Ključne besede**: morski psi, ribolov, Turčija, severovzhodno Egejsko morje, naključni ulov

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# ON THE OCCURRENCE OF THE PELAGIC STINGRAY, *DASYATIS VIOLACEA* (BONAPARTE, 1832), IN THE GULF OF TRIESTE (NORTHERN ADRIATIC)

*Borut MAVRIČ*
SI-1117 Ljubljana, Zoletova ulica 5

*Radoš JENKO*
Delamaris d.d., SI-6310 Izola, Tovarniška 13

*Tihomir MAKOVEC & Lovrenc LIPEJ*
Marine Biology Station, National Institute of Biology, SI-6330 Piran, Fornače 41

## *ABSTRACT*

*The pelagic stingray* Dasyatis violacea *(Bonaparte, 1832) has been recorded for the very first time off the Slovenian coast in the Gulf of Trieste (Northern Adriatic). Data on morphometrics and feeding habits of nine specimens collected are presented in the article. The main fish preyed were anchovies* (Engraulis encrasicolus) *and red bandfish* (Cepola rubescens).

**Key words:** *Dasyatis violacea,* Dasyatidae, first record, Gulf of Trieste, Adriatic Sea

# IL TRIGONE VIOLA *DASYATIS VIOLACEA* (BONAPARTE, 1832) NEL GOLFO DI TRIESTE (ADRIATICO SETTENTRIONALE)

*SINTESI*

*Gli autori fanno un resoconto su nove esemplari di Trigone viola,* Dasyatis violacea *(Bonaparte, 1832) catturati dalle reti nel Golfo di Trieste nel corso del 2004. E' la prima segnalazione della presenza di questa specie nelle acque slovene e in genere nel Golfo di Trieste. Sono indicati pure i loro dati morfometrici e alcuni particolari relativi alle loro abitudini alimentari. La maggior parte delle prede era costituita da pesci, in particolare alici* (Engraulis encrasicolus) *e cepole* (Cepola rubescens). *Gli autori ritengono che il Trigone viola fosse presente nel golfo già da prima, ma i pescatori ributtavano in mare gli esemplari catturati.*

**Parole chiave:** *Dasyatis violacea*, Dasyatidae, prima segnalazione, Golfo di Trieste, Mare Adriatico

## INTRODUCTION

For the Adriatic Sea, Jardas (1996) listed only *Dasyatis pastinaca* as a common species, *D. centroura* as a rare species (see also Dulčić *et al.*, 2003) and *D. violacea* as a very rare species. According to McEachran & Capapé (1984), one more *Dasyatis* species occurs in the Adriatic, *e.g. Dasyatis tortonesei* (Capapé, 1977), a species close to *D. pastinaca*.

Pelagic stingray is a relatively small ray with a maximum disk width of 80 cm (Mollet, 2002). It is dark with a typically broadly rounded snout and an angular pectoral disc without thorns (Compagno *et al.*, 1989). The colour of both sides is usually uniformly violet, purple, or dark blue-green dorsally and ventrally, without any prominent markings. It is found in tropical to warm temperate waters usually in the first 100 m (McEachran & Capapé, 1984). In the Mediterranean, it occurs mainly in waters off the African coasts (Hemida *et al.*, 2003), in the Ligurian Sea (Orsi Relini *et al.*, 2000), in waters off Sicily (McEachran & Capapé, 1984), and in waters off Greece and Israel (Hemida *et al.*, 2003).

As already pointed above, Jardas (1996) stated that the pelagic stingray was very rare in the Adriatic Sea. Bello (1999), on the other hand, wrote that this species was being captured by drifting longline in the Southern Adriatic and in the Gulf of Taranto. The same author also mentioned catches of this species in the Northern Adriatic on the basis of personal communication by I. Bianchi.

Since there has been a lack of records, this species has not been included in the key for the identification of cartilaginous fish of Slovenia (Lipej, 1999). The aim of this report is to hereby present the first data on the occurrence of pelagic stingrays in Slovenian coastal waters. Data on morphometrics and feeding habits of nine specimens collected are presented in this article.

## MATERIAL AND METHODS

Between May and September 2004, nine pelagic stingray specimens were caught by fishermen with pelagic trawl on muddy substrate in the Gulf of Trieste (Fig. 1). Soon after their capture, the specimens were frozen and stored in deep freeze chambers of the fishing enterprise Delamaris d.d. in Izola. Specimens were identified according to keys of McEachran & Capapé (1984) and Jardas (1996). The stingrays were measured according to the recommendations by Jardas (1996) to the nearest millimetre (Fig. 2). Sex was determined according to the presence of pterygoids. Specimens were photographed and subsequently dissected for the assessment of their food habits. Stomachs were accurately checked for food items and washed with seawater. The entire material was stored in 5% formaline. Fish remains were identified using the determination keys, such as Whitehead *et al.* (1984) and Marčeta (1999). Afterwards, the specimens were discarded.

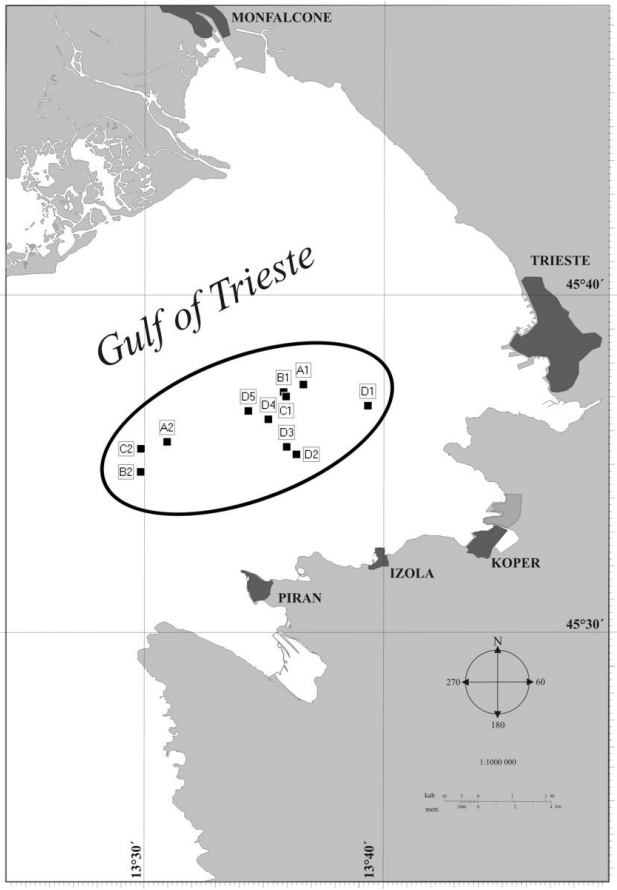


***Fig. 1: Study area with sampling sites, where pelagic stingrays were caught.***
***Sl. 1: Raziskovano območje z vzorčišči, na katerih so bili ujeti vijoličasti morski biči.***

## RESULTS AND DISCUSSION

The main morphometric data of the nine pelagic stingray specimens are presented in Table 1. Among the nine specimens (Fig. 3), 8 were females. The size varied from the smallest specimen, measuring 410 mm (disk width), to the largest measuring 650 mm (disk width – DW).

***Tab. 1: Measurements (in mm) for the nine specimens of** Dasyatis violacea**.***
***Tab. 1: Mere (v mm) za devet primerkov vrste** Dasyatis violacea**.***

| **Specimens** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **Average (±SD)** |
|---|---|---|---|---|---|---|---|---|---|---|
| Internasal length (IN) | 57 | 51 | 43 | 55 | 45 | 58 | 40 | 50 | 40 | 48.8 (7.1) |
| Mouth width (LO) | 65 | 62 | 49 | 65 | 54 | 60 | 45 | 58 | 46 | 56.0 (7.8) |
| Eyeball length (O) | 17 | 19 | 15 | 19 | 15 | 16 | 14 | 16 | 16 | 16.3 (1.7) |
| Snout tip to eye (POC) | 65 | 58 | 52 | 64 | 52 | 72 | 54 | 62 | 50 | 58.8 (7.5) |
| Disk width (LAD) | 615 | 500 | 440 | 580 | 480 | 650 | 450 | 566 | 410 | 521.2 (84.4) |
| Trunk length (LTR) | 255 | 238 | 171 | 278 | 190 | 290 | 200 | 246 | 170 | 226.4 (45.2) |
| Head length (LC) | 193 | 180 | 169 | 186 | 180 | 230 | 160 | 190 | 150 | 182.0 (22.9) |
| Snout tip to mouth (PO) | 80 | 70 | 66 | 93 | 69 | 84 | 65 | 68 | 60 | 72.8 (10.6) |
| Disk length (LOD) | 500 | 460 | 380 | 482 | 386 | 530 | 370 | 432 | 330 | 430.0 (67.6) |
| Tail length (LCA) | 875 | 595 | 756 | 831 | 649 | 840 | 420 | 900 | 810 | 741.8 (157.7) |
| Sex | f | f | m | f | f | f | f | f | f | |
| Date | Aug | Aug | Aug | Aug | Aug | Sep | Sep | Sep | Sep | |

***Tab. 2: Prey items found in stomachs of nine specimens of pelagic stingray** (Dasyatis violacea).*
***Tab. 2: Ostanki plena iz želodcev devetih primerkov vijoličastega morskega biča** (Dasyatis violacea).*

| **Specimens** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **Σ** | **%** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Engraulis encrasicolus* | | 10 | | 12 | 3 | 5 | | 11 | 4 | 45 | 54.88 |
| *Sardina pilchardus* | | 1 | | | 3 | | | 1 | | 5 | 6.10 |
| Clupeidae | | 2 | | | 1 | 2 | | | 1 | 6 | 7.32 |
| *Trachurus trachurus* | | | | | | 1 | | | | 1 | 1.22 |
| *Trachurus* sp. | | | | | | 3 | | | | 3 | 3.66 |
| *Merluccius merluccius* | | | | | | 3 | | | | 3 | 3.66 |
| *Hippocampus hippocampus* | | | | | | | | 1 | | 1 | 1.22 |
| *Cepola rubescens* | 3 | 1 | | | | | 4 | 1 | | 9 | 10.98 |
| *Serranellus hepatus* | 1 | | | | | | | | | 1 | 1.22 |
| *Trisopterus minutus capelanus* | 2 | | | | | | | | | 2 | 2.44 |
| *Gobius* sp. | 1 | | | | | | | | | 1 | 1.22 |
| Teleostei indet. | 2 | | 1 | 1 | | | | | | 4 | 4.88 |
| **Teleosts total** | **9** | **14** | **1** | **13** | **7** | **14** | **4** | **14** | **5** | **81** | **98.78** |
| *Sepia* sp. | | | | | | 1 | | | | 1 | 1.22 |
| **Cephalopoda total** | | | | | | **1** | | | | **1** | **1.22** |
| **Prey items** | **9** | **14** | **1** | **13** | **7** | **15** | **4** | **14** | **5** | **82** | **100** |

These data are in agreement with the size range of adult specimens recorded by Hemida *et al.* (2003), who reported on adult males from different Mediterranean areas, ranging from 420 to 580 mm, and adult females ranging from 450 to 610 mm DW. Only the 410 mm long female could be considered a subadult specimen.

Eighty-two prey items of 10 different species were removed from the stomachs (Tab. 2). All stomachs contained some food, ranging from 1 to 15 food items (mean 9.11). Food items of the nine specimens showed that in the Gulf of Trieste the pelagic stingray fed on teleosts, which constituted more than 98% of all prey items; cephalopods were occasionally ingested. The main teleosts preyed were anchovies *Engraulis encrasicolus* (54.9%), *Sardina pilchardus* (6.1.0%) and other clupeids (more than 66% of all prey items), moreover, the red bandfish *Cepola rubescens* (11.0%) was also frequently ingested (11.0%). The majority of the teleost species found in stomach contents were pelagic (Fig. 4), and these findings confirm the pelagic diet of *D. violacea.*

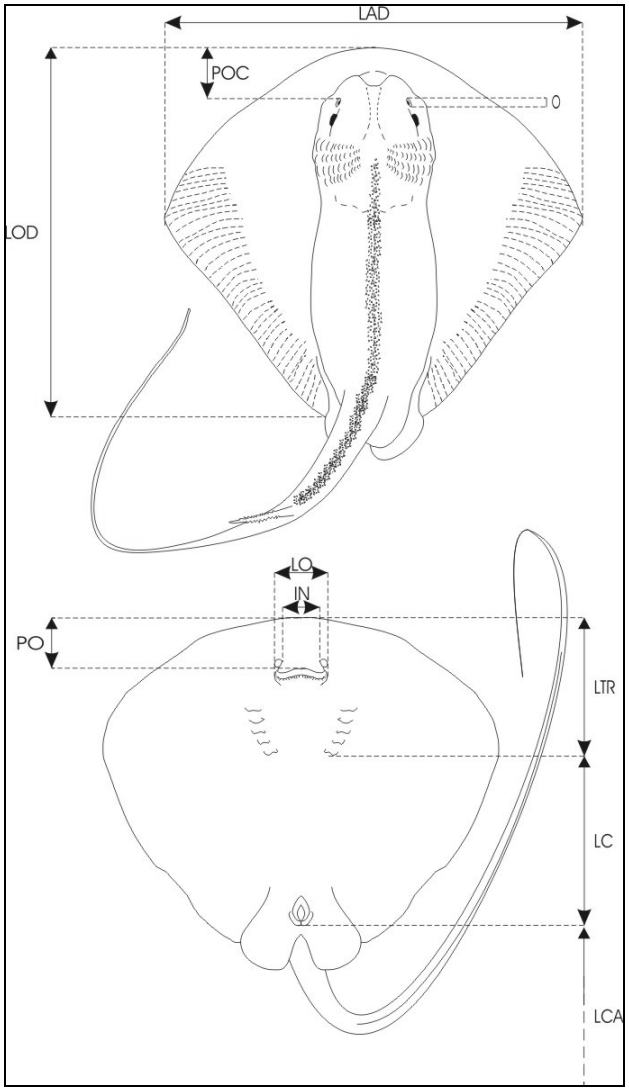


***Fig. 2: Morphometric measurements, according to Jardas (1996). Legend: LAD – disk width, LOD – disk length, O – eyeball length, POC – snout tip to eye distance, LC – head length, PO – snout tip to mouth distance, IN – internasal length, LO – mouth width, LCA – tail length, LTR – trunk length.***
***Sl. 2: Morfometrične dimenzije po Jardasu (1996). Legenda: LAD – širina diska, LOD – dolžina diska, O – dolžina zrkla, POC – razdalja med očmi in konico gobca, LC – dolžina glave, PO – razdalja med usti in konico gobca, IN – mednosnična dolžina, LO – širina ust, LCA – dolžina repa, LTR – dolžina trupa.***

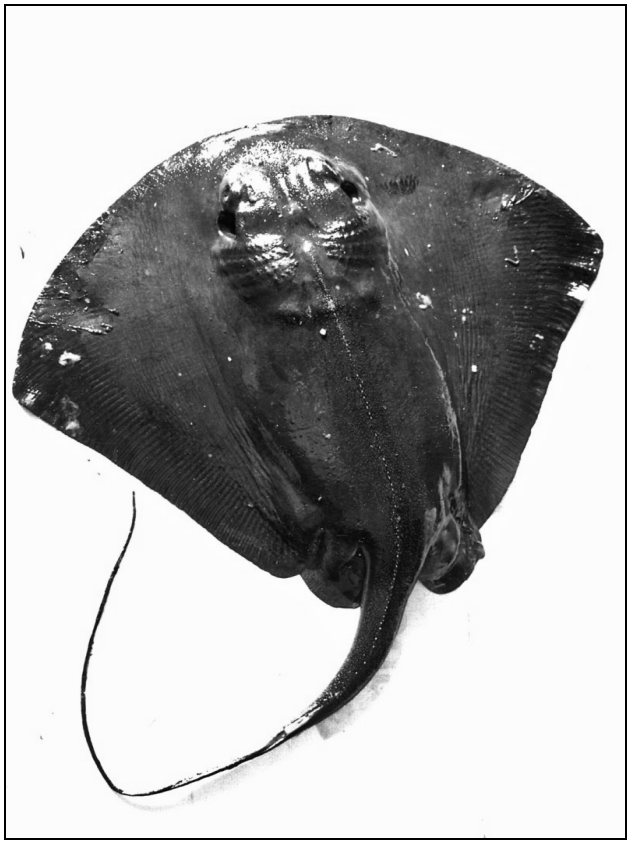

***Fig. 3: Pelagic stingray,*** *Dasyatis violacea,* ***caught in August 2004 in waters off Piran. (Photo: L. Lipej)***
***Sl. 3: Vijoličasti morski bič,*** *Dasyatis violacea,* ***ujet avgusta 2004 v vodah nedaleč od Pirana. (Foto: L. Lipej)***

According to the information obtained from fishermen, few pelagic stingray specimens have already been caught in the last ten years. One was even housed for some weeks in the Piran Aquarium (V. Žiža, *pers. comm.*). The lack of data on the occurrence of pelagic stingray in the Adriatic could probably be due to the fact that the specimens are regularly discarded at sea by fisherman. A closer and improved cooperation between fishermen and scientists should therefore be established for a better surveillance of the Northern Adriatic and its biodiversity.

## ACKNOWLEDGMENTS

The authors wish to express their gratitude to Bojan Marčeta and Valter Žiža for providing them with useful information and two anonymous referees for their valuable suggestions. They wish to thank the fishermen, who provided them with strigrays.

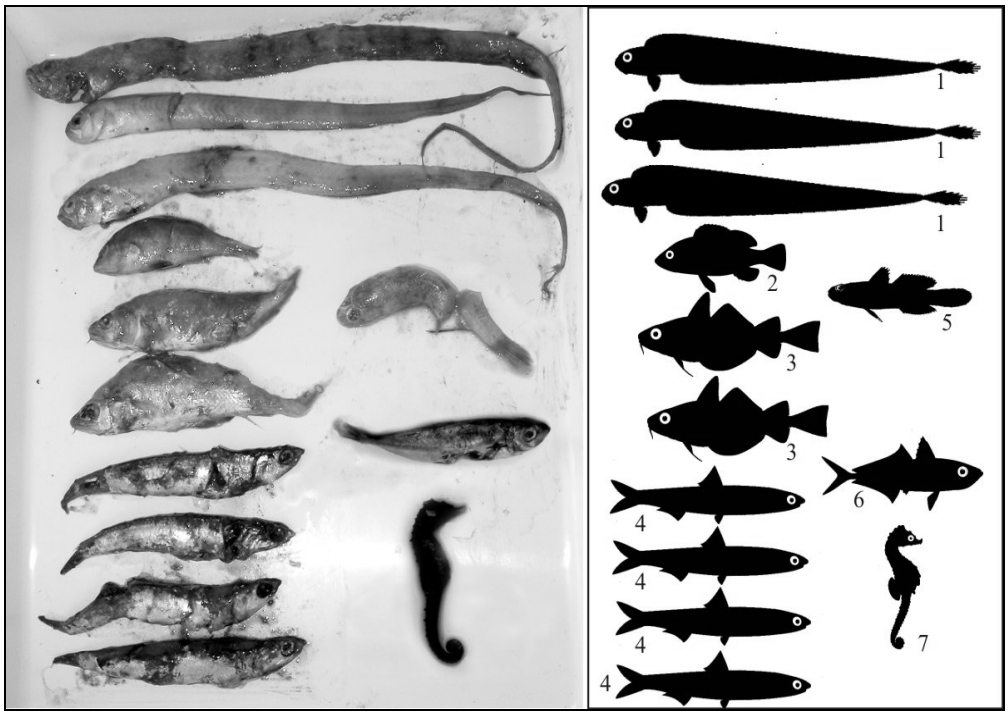


***Fig. 4: Some fish preyed by pelagic stingrays (specimens 1, 6 and 8) caught in waters off Piran in 2004. Legend: 1 –*** *Cepola rubescens****, 2 –*** *Serranus hepatus****, 3 –*** *Trisopterus minutus capelanus****, 4 –*** *Engraulis encrasicolus****, 5 –*** *Gobius* ***sp., 6 –*** *Trachurus trachurus* ***and 7*** *– Hippocampus hippocampus****.***
***Sl. 4: Nekatere izmed ribjih vrst, s katerimi so se hranili vijoličasti morski biči (primerki 1, 6 in 8), ujeti leta 2004 v vodah nedaleč od Pirana. Legenda: 1 –*** *Cepola rubescens****, 2 –*** *Serranus hepatus****, 3 –*** *Trisopterus minutus capelanus****, 4 –*** *Engraulis encrasicolus****, 5 –*** *Gobius* ***sp., 6 –*** *Trachurus trachurus* ***in 7 –*** *Hippocampus hippocampus****.***

# O POJAVLJANJU VIJOLIČASTEGA MORSKEGA BIČA *DASYATIS VIOLACEA* (BONAPARTE, 1832) V TRŽAŠKEM ZALIVU (SEVERNI JADRAN)

*Borut MAVRIČ*
SI-1117 Ljubljana, Zoletova ulica 5

*Radoš JENKO*
Delamaris d.d., SI-6310 Izola, Tovarniška 13

*Tihomir MAKOVEC & Lovrenc LIPEJ*
Morska biološka postaja, Nacionalni inštitut za biologijo, SI-6330 Piran, Fornače 41

*POVZETEK*

*Avtorji poročajo o devetih primerkih vijoličastega morskega biča,* Dasyatis violacea *(Bonaparte, 1832), ki so se poleti leta 2004 ujeli v ribiške mreže v Tržaškem zalivu. Gre za prvi zapis o pojavljanju te vrste v slovenskem morju in Tržaškem zalivu sploh. Avtorji med drugim navajajo morfometrične podatke ujetih primerkov in nekaj podatkov o njihovih prehranjevalnih navadah. Veliko večino plena so sestavljale ribe, med njimi pa pretežno inčuni* (Engraulis encrasicolus) *in rdeči mečaki* (Cepola rubescens). *Avtorji domnevajo, da so se vijoličasti morski biči na obravnavanem območju verjetno pojavljali tudi prej, vendar so jih ribiči takoj po ulovu običajno zavrgli.*

**Ključne besede:** *Dasyatis violacea,* Dasyatidae, prvi zapis, Tržaški zaliv, Jadransko morje

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# FEEDING HABITS OF THE MEDITERRANEAN POOR COD *TRISOPTERUS MINUTUS CAPELANUS* (LACEPÈDE) (PISCES: GADIDAE) FROM THE EASTERN CENTRAL ADRIATIC

*Jakov DULČIĆ*
Institute of Oceanography and Fisheries, HR-21000 Split, P.O.BOX 500, Croatia
E-mail: dulcic@izor.hr

*Zrinka DULČIĆ*
Sardina d.d., HR-21420 Postira, Croatia

## *ABSTRACT*

*The stomach contents of poor cod* Trisopterus minutus capelanus *(Lacepède) were taken at monthly intervals off the eastern Central Adriatic coast (Croatia) between March 2003 and January 2004. A total of 273 specimens were analysed to determine diet according to fish size and season. The basic food consists of crustaceans (Mysidacea and Decapoda) and teleosts. Feeding habits varied with size: decapods and fish were more abundant in the stomachs of larger specimens. Moderate seasonal variation in food habits was recorded.*

**Key words:** *Trisopterus minutus capelanus*, poor cod, feeding habits, Adriatic Sea

# ABITUDINI ALIMENTARI DELLA BUSBANA *TRISOPTERUS MINUTUS CAPELANUS* (LACEPÈDE) (PISCES: GADIDAE) DELL'ADRIATICO CENTRO – ORIENTALE

*SINTESI*

*Tra marzo 2003 e gennaio 2004 è stato effettuato un esame a intervalli mensili del contenuto dello stomaco di busbane* Trisopterus minutus capelanus *(Lacepède) pescate nelle acque croate del Medio Adriatico. Per accertare le abitudini alimentari di questa specie, in relazione alle loro dimensioni e alla stagione, sono stati esaminati 273 esemplari. Il cibo principale era costituito da crostacei (Mysidacea e Decapoda) e teleostei. Le abitudini alimentari variavano a seconda delle dimensioni: decapodi e pesci erano più abbondanti nello stomaco degli esemplari più grandi. Nelle abitudini alimentari sono state registrate anche moderate variazioni stagionali.*

**Parole chiave:** *Trisopterus minutus capelanus*, busbana, abitudini alimentari, Mare Adriatico

## INTRODUCTION

The poor cod, *Trisopterus minutus capelanus* (Lacepède), is one of the most abundant endemic fish species in the Mediterranean Sea. Its distribution extends to the eastern Atlantic Ocean off the coast of Morocco, whereas north of Gibraltar the subspecies *Trisopterus minutus minutus* is found. However, recent genetic analysis (Mattiangeli *et al.*, 2000) supports the classification of Atlantic and Mediterranean poor cod as distinct taxa and the close relationship between the Mediterranean poor cod and bib *Trisopterus luscus* (Linnaeus, 1758).

The poor cod is among the most abundant gadoid fishes in the Central Adriatic. Here it is actively exploited by bottom trawlers on muddy or sandy-muddy bottoms at depths ranging from 40 to 250 m (Jardas, 1996). Despite its commercial value and abundance in the fisheries of Mediterranean countries, little is known about the trophic ecology of the Mediterranean poor cod. Planas & Vives (1952) made some observations on its diet off the Mediterranean coast of Spain, while Politou *et al.* (1989) presented some preliminary information on the feeding habits of the species in the Euboikos and Pagassitikos Gulfs in Greece. Politou & Papaconstantinou (1994) reported on the feeding ecology of poor cod from the eastern coast of Greece. Biagi *et al.* (1992) made some observations in the northern Tyrrhenian Sea, while Gramitto (1999) presented data on the feeding habits and estimation of daily ration of poor cod in the Adriatic Sea. Morte *et al.* (2001) studied the poor cod's feeding habits off the eastern coast of Spain (western Mediterranean).

The main goal of this study was to present information on the feeding ecology of poor cod *T. m. capelanus* in the Central Adriatic (eastern coast), including the systematic and detailed study of its prey, and the influence of predator size and seasonal variations in the stomach contents.

## MATERIAL AND METHODS

Monthly samples of *T. m. capelanus* were collected from diurnal commercial catches landed in the port of Šibenik; the catches were taken by trawl (type "tartana") at 50 to 175 m depth in the area of Vis Island and Jabuka Pit (Blitvenica area) between March 2003 and January 2004. A total of 273 specimens (108 females, 41 males) with a total length between 8.3 cm and 24.0 cm were measured, dissected and their stomachs removed and preserved in 4% formaldehyde. Upon opening, stomach contents were preserved in a 70% ethanol solution. A few fish showing evidence of regurgitation were excluded from the study.

In the laboratory, identification of prey was carried out at the lowest possible taxonomic level. We registered the number and wet weight of food items after removing surface water by blotting it on tissue paper.

The distribution of each feeding item in the diet was determined by the frequency of occurrence (F %), numerical composition (Cn %) and biomass composition (Cw %) (Hyslop, 1980). The percentage of empty stomach (V) was also recorded. Indices of relative importance (Pinkas *et al.*, 1971) (IRI= (%N + %W) %F) and main food items (MFI = ((%N + %F)/2) %W) (Zander, 1982) were calculated for each consumed prey item. To assess potential diet changes with respect to size, fish were divided into two size classes according to age classes: small (≤14 cm) and large (≥14.5 cm).

The proportional food overlap between the size classes and seasons was calculated using the Schoener overlap index (1970):

$$a = 1 - 0.5 \left( \sum_{i-1} |p_{xi} - p_{yi}| \right)$$

where $p_{xi}$ and $p_{yi}$ are the biomass composition indices of prey (i) in the diets of size classes x and y, respectively. The index has a minimum value of zero when no overlap occurs and a maximum value of one when all prey are shared in equal proportions by two size classes. Statistical differences in diet composition as a function of size and season were assessed using the chi-square $\chi^2$ test (Sokal & Rohlf, 1981). The significance of variation of the mean number of prey and weight per stomach was tested by analysis of variance (ANOVA).

## RESULTS

### Emptiness index

Of the 273 stomachs of *T. m. capelanus* examined, 20 were empty (7.32 %). This percentage did not vary significantly over the year ($\chi^2$ = 1.17, df = 3, P >0.05). However, the emptiness index varied significantly with poor cod size ($\chi^2$ = 7.56, df = 1, P <0.05). Somewhat higher value of this index was obtained in the smaller group (smallest specimens).

### Overall composition of the diet and variation in stomach contents relative to fish length

The stomach contents of the poor cod consisted of at least 37 different prey species, with a low average number of prey per stomach (2.49) and low average weight of prey per stomach (0.37). The food consisted almost exclusively of crustaceans and fish, the former constituting a much greater part then the latter. The crustaceans were mainly mysids and decapods *(Peneus* sp., *Alpheus glaber).* The fish were mainly gobiids. Less abundant crustaceans included copepods, euphausiids and stomatopods. Other taxa found in the stomach con

***Tab. 1: Prey registered in the stomach of** T. m. capelanus **(small size group ≤14 cm) (F % – frequency of occurrence, Cn % – numerical composition, Cw % – biomass composition) (No. = 96).***
***Tab. 1: Plen, zabeležen v želodcu moliča** T. m. capelanus **(skupina manjših primerkov ≤14 cm) (F % – frekvenca pojavljanja, Cn % – številčna sestava, Cw % – sestava biomase) (No. = 96).***

| **Food items** | **F (F %)** | **N (Cn %)** | **W (Cw %)** |
|---|---|---|---|
| **Polychaeta** | | | |
| *Aphrodite acuelata* | 1 (1.04) | 1 (0.35) | 0.01 (0.06) |
| **Tunicata** | | | |
| Appendicularia | 1 (1.04) | 1 (0.35) | 0.01 (0.06) |
| **Crustacea** | | | |
| Mysidacea | 41 (42.70) | 115 (41.21) | 0.72 (4.53) |
| Euphausiacea | 2 (2.08) | 2 (0.71) | 0.01 (0.06) |
| Stomatopoda | | | |
| *Squilla* sp. | 5 (5.20) | 6 (2.15) | 0.23 (1.44) |
| Decapoda | | | |
| Penaeidae | | | |
| *Penaeus* sp. | 35 (36.45) | 77 (27.59) | 5.97 ( 37.57) |
| *Penaeus kerathurus* | 1 (1.04) | 1 ( 0.35) | 0.12 (0.75) |
| *Parapenaeus longirostris* | 3 (3.12) | 3 ( 1.07) | 0.52 (3.27) |
| **Total Penaeidae** | 39 (40.62) | 81 (29.03) | 6.61 (41.59) |
| Alpheidae | | | |
| *Alpheus* sp. | 7 (7.29) | 8 ( 2.86) | 1.15 (7.23) |
| *Alpheus glaber* | 10 (10.41) | 12 ( 4.30) | 1.21( 7.61) |
| **Total Alpheidae** | 17 (17.70) | 20 ( 7.16) | 2.36 ( 14.85) |
| Pasiphaeidae | | | |
| *Pasiphea sivado* | 3 ( 3.12) | 4 ( 1.43) | 0.16 ( 1.00) |
| Pandalinae | | | |
| *Plesionika martia* | 1 (1.04) | 1 (0.36) | 0.04 (0.25) |
| *Pandalina brevirostris* | 1 (1.04) | 2 (0.71) | 0.04 (0.25) |
| **Total Pandalinae** | 2 (2.08) | 3 (1.07) | 0.08 (0.50) |
| Hippolytidae | | | |
| *Lysmata seticaudata* | 1 (1.04) | 1 (0.36) | 0.08 (0.50) |
| Nephropidae | | | |
| *Nephrops norvegicus* | 2 (2.08) | 2 (0.72) | 0.86 (5.41) |
| Paguridea | | | |
| *Pagurus* sp. | 1 (1.04) | 1 (0.36) | 0.01 (0.06) |
| Albuneidae | | | |
| *Albunea carabus* | 1 (1.04) | 1 (0.36) | 0.02 (0.12) |
| Portunidae | | | |
| *Macropipus* sp. | 1 (1.04) | 1 (0.36) | 0.04 (0.25) |
| Xanthidae | | | |
| *Xantho* sp. | 2 ( 2.08 ) | 2 (0.72) | 0.04 (0.25) |
| Goneplacidae | | | |
| *Goneplax rhomboides* | 8 (8.33) | 9 (3.23) | 2.07 (13.02) |
| Decapoda | 15 (15.63) | 21 (7.53) | 1.78 (11.20) |
| **Total Crustacea** | 140 (145.83) | 269 (96.76) | 15.06 (94.77) |
| **Pisces** | | | |
| *Gobius* sp. | 3 (3.12) | 3 (1.07) | 0.49 (3.08) |
| Pisces | 4 (4.16) | 4 (1.43) | 0.32 (2.01) |
| **Total Pisces** | 7 (7.29) | 7 (2.51) | 0.81 (5.09) |
| **Algae (Phaeophyta)** | 1 (1.04) | 1 (0.36) | 0 |

***Tab. 2: Prey registered in the stomach of** T. m. capelanus **(large size group ≥14.5 cm) (F % – frequency of occurrence, Cn % – numerical composition, Cw % – biomass composition) (No. = 177).***
***Tab. 2: Plen, zabeležen v želodcu moliča** T. m. capelanus **(skupina večjih primerkov ≥14,5 cm) (F % – frekvenca pojavljanja, Cn % – številčna sestava, Cw % – sestava biomase) (No. = 177).***

| **Food items** | **F (F %)** | **N (Cn %)** | **W (Cw %)** |
|---|---|---|---|
| **Polychaeta** | | | |
| *Aphrodite acuelata* | 4 (2.26) | 5 (1.24) | 0.05 (0.08) |
| **Bryozoa** | 4 (2.26) | 4 (0.99) | 0.03(0.05) |
| **Crustacea** | | | |
| Mysidacea | 18 (10.16) | 41 (10.22) | 0.04 (0.07) |
| Copepoda | | | |
| Nauplia | 1 (0.56) | 1 (0.25) | 0 |
| Stomatopoda | | | |
| *Squilla desmaresti* | 2 (1.13) | 2 (0.49) | 0,03 (0,05) |
| *Squilla* sp. | 1 (0.56) | 1 (0.25) | 0,14 (0,24) |
| **Total Stomatopoda** | 3 (1.69) | 1 (0.25) | 0,17 (0,30) |
| Decapoda | | | |
| Penaeidae | | | |
| *Penaeus* sp. | 59 (33.33) | 103 (25.68) | 9.56 (17.01) |
| *Penaeus kerathurus* | 5 (2.82) | 5 (1.24) | 1.3 (2.31) |
| *Stenopus spinosus* | 2 (1.13) | 2 (0.49) | 0.19 (0.33) |
| *Metapenaeus monoceros* | 1 (0.56) | 1 (0.25) | 0.09 (0.16) |
| *Gennades elegans* | 1 (0.56) | 1 (0.25) | 0.11 (0.19) |
| *Parapenaeus longirostris* | 4 (2.26) | 4 (0.99) | 1.03 (1.83) |
| **Total Penaeidae** | 72 (40.67) | 116 (28.92) | 12.28 (21.85) |
| Alpheidae | | | |
| *Alpheus* sp. | 29 (16.38) | 33 (8.23) | 6.42 (11.42) |
| *Alpheus glaber* | 26 (14.69) | 28 (6.98) | 6.15 (10.94) |
| **Total Alpheidae** | 55 (31.07) | 61 (15.21) | 12.57 (22.36) |
| Pasiphaeidae | | | |
| *Pasiphea sivado* | 5 (2.82) | 9 (2.24) | 0.72 (1.28) |
| Pandalinae | | | |
| *Pandalina brevirostris* | 1 (0.56) | 1 (0.25) | 0.01 (0.07) |
| Nephropidae | | | |
| *Nephrops norvegicus* | 11 (6.21) | 11 (2.74) | 5.68 (10.10) |
| Palinuridea | | | |
| *Polycheles typhlops* | 1 (0.56) | 1 (0.25) | 0.3 (0.53) |
| Portunidae | | | |
| *Macropipus depurator* | 2 (1.13) | 2 (0.49) | 0.11 (0.19) |
| Xanthidae | | | |
| *Xantho* sp. | 2 (1.13) | 2 (0.49) | 0.06 (0.10) |
| Goneplacidae | | | |
| *Goneplax rhomboids* | 23 (12.99) | 27 (6.73) | 4.54 (8.07) |
| Crangonidae | | | |
| *Crangon crangon* | 1 (0.56) | 1 (0.25) | 0.07 (0.12) |
| Palaeomonidae | | | |
| *Paleomon* sp. | 3 (1.69) | 3 (0.74) | 0.08 (0.14) |
| Galatheidea | | | |
| *Munida* sp. | 3 (1.69) | 3 (0.74) | 0.12 (0.21) |
| Isopoda | | | |
| *Ligia italica* | 1 (0.56) | 1 (0.25) | 0.23 (0.40) |

| | | | |
|---|---|---|---|
| Epicaridea | 1 (0.56) | 1 (0.25) | 0.01 (0.01) |
| Decapoda | 33 (18.64) | 53 (13.21) | 3.73 (6.63) |
| **Total Crustacea** | 236 (133.33) | 337 (84.03) | 40.72 (72.45) |
| **Pisces** | | | |
| *Gobius* sp. | 23 (12.99) | 27 (6.73) | 8.01 (14.25) |
| *Engraulis encrasicolus* | 1 (0.56) | 1 (0.25) | 2.8 (4.98) |
| Other fish | 22 (12.43) | 23 (5.73) | 4.59 (8.16) |
| Fish eggs | 1 (0.56) | 1 (0.25) | 0 |
| **Total Pisces** | 47 (26.55) | 52 (12.96) | 15.4 (27.4) |
| **Algae (Phaeophyta)** | 3 (1.69) | 3 (0.74) | 0 |

tents, but of lesser importance, were bryozoans, polychaetes, tunicates and algal remains. According to IRI, Penaeidae represented the highest portion.

Tables 1 and 2 show the frequency of occurrence, numerical composition and biomass composition of all prey items found in small (≤14 cm) and large (≥14.5 cm) size groups. Tables 3 and 4 show the values of IRI and MFI for small (≤14 cm) and large (≥14.5 cm) size groups.

***Tab. 3:*** *T. m. capelanus*. ***The values of IRI and MFI (No. = 96).***
***Tab. 3:*** *T. m. capelanus*. ***Vrednosti IRI in MFI indeksov (No. = 96).***

| Food items | MFI | IRI |
|---|---|---|
| **Polychaeta** | 0.044056 | 0.438912 |
| Tunicata | 0.044056 | 0.38912 |
| **Crustacea** | | |
| Mysidacea | 190.1429 | 1953.897 |
| Penaeidae | 1448.818 | 2869.374 |
| Alpheidae | 184.7364 | 389.9475 |
| Goneplacidae | 75.29081 | 135.4406 |
| Other Decapoda | 405.0783 | 938.0181 |
| **Total Crustacea** | 11496.21 | 27932.8 |
| **Pisces** | 24.97957 | 55.46411 |
| **Algae** | 0 | 0.373357 |

According to IRI and MFI, the main food of smaller poor cod specimens consisted of Mysidacea, Penaeidae, Alpheidae, Goneplacidae and other Decapods, while larger specimens fed on Decapoda (Penaeidae, Alpheidae) and pisces (Gobiidae). Although the average number of prey per stomach decreased from the smallest individuals to the largest, no significant differences were found ($F = 5.85$, $df = 272$, $P > 0.05$). The average prey weight per stomach, however, increased significantly ($F = 234.33$, $df = 272$, $F < 0.001$) from the smallest to the largest size classes. The value of various prey types varied with poor cod size: in Penaeidae, Alpheidae and Pisces it increased with the increasing poor cod size but decreased in mysids and Goneplacidae. There was a clear tendency for mysids ($\chi^2 = 124.82$, $P < 0.001$), Goneplacidae ($\chi^2 = 78.54$, $P < 0.001$) and "other crustaceans" ($\chi^2 = 38.68$, $P < 0.001$) to be mostly consumed by the small specimens. The chi-square test revealed significant differences among poor cod size classes with respect to decapods ($\chi^2 = 96.43$, $df = 2$, $P<0.001$) and teleosts ($\chi^2 = 98.39$, $P < 0.001$) due to the low number of prey in the small size class. The importance of mysid species decreased as predator size increased. An opposite trend was evident for the main decapod and teleost species, whose IRI increased considerably as the predator grew.

***Tab. 4:*** *T. m. capelanus*. ***The values of IRI and MFI (No. = 177).***
***Tab. 4:*** *T. m. capelanus*. ***Vrednosti IRI in MFI indeksov (No. = 177).***

| Food items | MFI | IRI |
|---|---|---|
| **Polychaeta** | 0.156 | 3.01887 |
| **Bryozoa** | 0.08694 | 2.37489 |
| **Crustacea** | | |
| Penaeidae | 760.46 | 2065.55 |
| Alpheidae | 517.622 | 1167.69 |
| Nephropidae | 45.2673 | 79.8582 |
| Goneplacidae | 79.6823 | 192.465 |
| Other Decapoda | 105.731 | 370.1587 |
| **Total Crustacea** | 7874.94 | 20866.1 |
| **Pisces** | 541.483 | 1071.96 |

**Seasonal variation in diet**

The average number of prey per stomach was significantly lower in the winter ($F = 64.70$, $df = 272$, $P < 0.001$), whereas the mean stomach weight was constant through the year ($F = 4.55$, $df = 272$, $P > 0.05$). The relative importance of *T. m. capelanus* prey groups changed seasonally, although decapod crustaceans were the dominant food in all seasons. According to IRI (4133.29) and MFI (1318.781) values, Penaeidae were dominant during the spring, while Alpheidae (IRI = 982.348, MFI = 397.788) were dominant during the autumn. Mysids were present in the stomach contents of poor cod throughout the year ($\chi^2 = 20.33$, $df = 3$, $P < 0.001$). Teleosts appeared most frequently in spring

(MFI = 865.833, IRI = 1887.436, $\chi^2$ = 12.50, P<0.01). Goneplacidae were frequent in the spring and autumn diet (MFI = 30.965, IRI = 69.229, MFI = 98.292, IRI = 205.142), while Nephropidae dominated during the spring (MFI = 128.341, IRI = 274.248).

### Diet overlap

The diet overlap, calculated on the basis of prey weight (Cw %), among fishes of different length groups in each season was moderate (0.62). Only in spring, a relatively high dietary overlap (0.76) was noted between size classes (Tab. 5).

***Tab. 5: Proportional food overlap coefficients of** T. m. capelanus **between seasons and size classes.***
***Tab. 5: Koeficienti proporcionalnega prehranskega prekrivanja moliča** T. m. capelanus **med letnimi časi glede na posamezne velikostne razrede te vrste.***

| | ≤14.0 cm | ≥14.5 cm |
|---|---|---|
| **Winter** | | |
| ≤14.0 cm | 0.78 | |
| ≥14.5 cm | 0.25 | 0.57 |
| **Spring** | | |
| ≤14.0 cm | 0.96 | |
| ≥14.5 cm | 0.56 | 0.76 |
| **Summer** | | |
| ≤14.0 cm | 0.74 | |
| ≥14.5 cm | 0.15 | 0.45 |
| **Autumn** | | |
| ≤14.0 cm | 0.78 | |
| ≥14.5 cm | 0.22 | 0.51 |

## DISCUSSION

Our study of *T. m. capelanus* in the eastern Central Adriatic shows that decapods (mostly shrimps, Penaeidae, Alpheidae, Goneplacidae) constitute the main identifiable prey. Mysids, although dominant in number, constitute only a small percentage by weight. Teleosts such as gobiids are also important, but only in larger size classes.

In general, our results agree with previous studies carried out in the Adriatic (Županović & Jardas, 1989; Gramitto, 1999) and other Mediterranean areas (Biagi *et al.*, 1992; Politou & Papaconstantinou, 1994; Morte *et al.*, 2001). Euphausiacea, found in the stomachs during this study, were not found in the stomachs of poor cod collected on the continental shelf of the Central Adriatic, where they were replaced by other crustaceans (Mysidacea and Amphipoda) (Gramitto, 1999). The found eggs and pleopods and occasional fragments of legs of large Decapods, or bites of fish meat together with detritus suggest that poor cod also feeds on dead organisms found on the sea floor, possibly trawler discards. The sporadic finds of remains of *T. m. capelanus* may be either the result of this behaviour or cannibalism, which had been previously confirmed by Gramitto (1999). The poor cod has a well developed barbel and long soft pelvic rays, indicating that it is adapted to feed mainly near the bottom. Moreover, its mouth is designed for quick suction of prey above the bottom (Mattson, 1990). The diet consists of benthic species *(A. glaber, Nephrops norvegicus, Gobius* sp.) or species living just above the bottom. Most of these preys live buried in the substratum. Prey-search must therefore be active, and the fish has to sweep its pelvic fin over the bottom to locate prey, as do other members of the family Gadidae (Marshall & Cohen, 1973).

The preference for bigger prey types as predator size increases in this species results in the replacement of some small food organisms (Mysidacea and Euphasiacea) by others of bigger size *(A. glaber,* teleosts). Similar results have been reported for other Mediterranean areas (Politou & Papaconstantinou, 1994; Gramitto, 1999; Morte *et al.*, 2001), although there are certain differences in the diet. Armstrong (1982) reported a gradual increase of *N. norvegicus* of the $0^+$ age class in the stomach contents with increasing predator size. In this study, *N. norvegicus* was found in the stomachs of both size classes (≤14.0 cm, ≥14.5 cm) and confirms the previous findings. Gramitto (1999) reported that small Norway lobsters were found in the stomachs of large poor cod specimens only four times in the Adriatic, even though the fish feeds intensively on other burrowing decapods of similar size living on "Nephrops grounds", such as *A. glaber*. The same author explained this with the behaviour of both predator and prey.

The low percentage of empty stomachs agrees with the observations of previous investigators for other areas (Biagi *et al.*, 1992; Politou & Papaconstantinou, 1994; Gramitto, 1999; Morte *et al.*, 2001). The low values of the vacuity index and the finding of filled stomachs all day round suggest that the poor cod is a continuous feeder, as hypothesised by Biagi *et al.* (1992) for the Tyrrhenian Sea. The analysis of stomach fullness in the 24 hours showed that *T. m. capelanus* is a continuous feeder, also if some periodicity can be detected probably linked to different availability of the prey, due to their diet behaviour pattern (Gramitto, 1999). Reproduction, which takes place in the winter and early spring, seems to have little effect on vacuity, as this was constant throughout the year. Similar findings, as far as the Adriatic is concerned, have been reported by Gramitto (1999), whereas Politou & Papaconstantinou (1994) found a seasonal cycle with a maximum vacuity in winter off the eastern coast of Greece.

The poor cod's feeding habits changed seasonally. These changes could be due to the different depths of sampling sites, which are difficult to assess when sam-

ples are provided by professional fishermen. In this study, however, the fish were collected over a narrow depth range (50 to 175 m), where the structure of bottom communities is probably quite similar. Other factors should also be considered, such as temporal variation in abundance and/or prey availability of prey. A number of authors have shown that, as the density of particular prey type declines, a predator may switch to another, more abundant prey (Hume & Northcote, 1985; Davidson, 1986). Unfortunately, no data on the distribution and abundance of crustaceans are currently available to determine the food web in the area of investigation.

# PREHRANJEVALNE NAVADE MOLIČA *TRISOPTERUS MINUTUS CAPELANUS* (LACEPÈDE) (PISCES: GADIADE) V VZHODNEM SREDNJEM JADRANU

*Jakov DULČIĆ*
Inštitut za oceanografijo in ribištvo, HR-21000 Split, P.O.BOX 500, Hrvaška
E-mail: dulcic@izor.hr

*Zrinka DULČIĆ*
Sardina d.d., HR-21420 Postira, Hrvaška

*POVZETEK*

*V mesečnih intervalih med marcem 2003 in januarjem 2004 je bila pregledana vsebina želodcev moličev* Trisopterus minutus capelanus *(Lacepède), ujetih v hrvaških vodah vzhodnega srednjega Jadrana. Da bi ugotovili prehranjevalne navade te vrste glede na velikost primerkov in letne čase, je bilo skupaj pregledanih 273 primerkov. Njihovo osnovno hrano so sestavljali raki (Mysidacea in Decapoda) in prave kostnice, glede na velikost primerkov pa je bilo v želodcih večjih moličev ugotovljenih več deseteronožcev in rib kot v želodcih manjših primerkov. V prehranjevalnih navadah te vrste so bili zabeleženi tudi zmerni odkloni glede na posamezne letne čase.*

**Ključne besede:** *Trisopterus minutus capelanus*, molič, prehranjevalne navade, Jadransko morje

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# LENGTH-WEIGHT RELATIONSHIPS OF FISHES FROM TURKISH SEAS: A REVIEW

*Hatice TORCU KOÇ & Zeliha AKA ERDOĞAN*
University of Balikesir, Faculty of Science and Arts, Department of Biology, TR-10100 Balikesir, Turkey

*Jakov DULČIĆ*
Institute of Oceanography and Fisheries, HR-21000 Split, P.O. BOX 500, Croatia
E-mail: dulcic@izor.hr

## *ABSTRACT*

*The paper presents 360 length-weight relationships gathered from available literature pertaining to 90 fish species belonging to 40 families occurring throughout Turkish seas. The value of the slope b ranged from 0.409 for* Thunnus thynnus *to 4.343 for* Dentex macrophthalmus*. The mean value of b was 3.088 (± SD = 0.898) and did not differ significantly from 3* (t-*test, p <0.05). The median value of b was 3.062 and 50% of b values ranged between 2.941 and 3.190.*

**Key words:** length-weight relationship, fishes, Turkish seas, review

# RAPPORTO PESO/LUNGHEZZA DEI PESCI NEI MARI DELLA TURCHIA: UNA RASSEGNA

*SINTESI*

*Sulla base dei dati messi a disposizione dall'attuale letteratura, l'articolo elenca 360 esempi di rapporto peso/lunghezza di pesci appartenenti a 90 specie e 40 famiglie che dimorano nei mari della Turchia. La curva (b) va dallo 0,409 della specie* Thunnus thynnus *al 4,343 di quella del* Dentex macrophthalmus*. Il valore medio di b è 3,088 (± SD = 0,898) e si discosta pochissimo dal 3* (t-*test, p<0,05). La mediana del coefficente b è di 3,062, mentre il 50 % del valore di b oscilla tra 2,941 e 3,190.*

**Parole chiave:** rapporto peso/lunghezza, pesci, mari della Turchia, rassegna

## INTRODUCTION

Recording length and weight data is a standard procedure of fish sampling programs. Such data are essential for studies of fish population dynamics. Length-weight relationships have a number of uses including: (a) the estimation of standing-crop biomass when the length-frequency distribution is known; (b) estimation of biomass from length observations because of technical difficulties (*e.g.* bobbing motion of the boat) and the amount of time required to record weight in the field; (c) the calculation of condition indexes in the analysis of ontogenetic changes; and (d) comparing the life stories and morphological variations of fish populations from different regions (Cailliet *et al.*,1986; Safran, 1992; Petrakis & Stergiou, 1995; Goncalves *et al.*, 1996; Martin-Smith, 1996; Morato *et al.*, 2001; Stergiou & Motopoulos, 2001; Filiz & Bilge, 2004).

In this review, we gathered 336 length-weight relationships from the available literature for 70 fish species from Turkish seas.

## MATERIAL AND METHODS

All length-weight relationships presented here are the product of field studies conducted during 1972–2004 in Turkish seas. For the majority of the original length-weight relationship ($W=aL^b$), length was expressed in cm and weight in g (356 relationships out of 360; 98.8%), whereas for 4 (1.2%) relationships, length and weight were expressed in mm and g.

## RESULTS AND DISCUSSION

Overall, 360 length-weight relationships, gathered from the literature, represent 90 species and 40 families occurring in Turkish marine waters (Tab. 1). Overall, 50 out of the 360 length-weight relationships refer to *Merluccius merluccius* (14.9%), 35 (10.4%) to *Mullus barbatus,* and 26 (7.7%) to *Pagellus erythrinus*, three of the most commercially important demersal species in Turkish seas. Regarding the number of studies, of which length-weight relationship of an individual family is recorded, Sparidae dominated the overall records (84, 25.0%), and followed by Mullidae (60, 17.9%), Merluccidae (50, 14.9%), Engraulidae (17, 5.1%) and Mugilidae (14, 4.2%). Each of the remaining 28 families was represented by less than one relationship.

The value of the slope b in the plot of log W against log W ranged from 0.409 for *Thunnus thynnus* in Aegean and Mediterranean Sea to 4.343 for *Dentex macrophthalmus* in Saros Bay. The mean value of b was 3.088 (± SD = 0.8985) and did not differ significantly from 3 (*t*-test, $p < 0.05$). The median value of b was 3.062 and 50 % of b values ranged between 2.941 and 3.19.

According to Stergiou & Moutopoulos (2001), a plot of a *versus* b for all known length-weight relationships of a species results in a linear relationship, and this relationship can be used to identify outliers. We have applied this method to all species with more than 10 length-weight relationships. This led to the detection of outliers, where the respective point deviated more than two standard deviations from the regression line. These length-weight relationships were marked as "questionable" in Table 1.

The length-weight relationship in fishes is affected by a number of factors, including season, habitat, gonad maturity, sex, diet and stomach fullness, health and preservation techniques (Dulčić & Kraljević, 1996), all of which were not accounted for in this review. As stressed by Bagenal & Tesch (1978) and Petrakis & Stergiou (1995), the use of relationships should be limited to the size range used to estimate the parameters. Extrapolation to juvenile or immature stages may be particularly unwise given the potential differences in growth patterns between adults and earlier life history stages (Bagenal & Tesch, 1978). The parameters of the length-weight relationship may vary significantly according to season, habitat and even on a daily basis *(ibid).* In fishes, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age-dependent (Dulčić & Kraljević, 1996). Consequently, variability in size has important implications for diverse aspects of fisheries science and population dynamics. Length-weight relationships have several applications, namely on fish biology, physiology, ecology and fisheries assessment. In biological studies, length-weight relationships enable seasonal variations in fish growth to be followed and the calcultaion of condition indexes. In fisheries studies, length-weight relationships have many different uses, including the estimation of weight from length, the estimation of weight-at-age and the conversion of growth-in-length equations to growth-in-weight. The establishment of length-weight relationships is also fundamental for the calculation of production and biomass of a fish population, being very useful for biomass estimations based on visual census of fish populations.

This review of length-weight parameters reported here will be of considerable use in ongoing studies of the catch in Turkish commercial fisheries.

***Tab. 1: Parameters of the length-weight relationship $W = aL^b$ of fish species from Turkish marine waters (length (cm), weight (g)).***
***Legend: Sex (M, male; F, female; C, combined; U, unidentified); Year = year of sampling; S = sampling season (AUT, Autumn; WI, Winter; SP, Spring; SU, Summer; C, All seasons); L = length (TL, Total length; FL, Fork length; SL, Standard length); a = intercept (from the literature); b = slope (of the relationship $W=aL^b$); $r^2$ = coefficient of correlation; N = sampling size; min and max = minimum and maximum sample lengths (cm); SD = standard deviation.***
***Species are listed in alphabetical order.***

***Tab. 1: Parametri razmerja $W = aL^b$ med dolžino in težo ribjih vrst, živečih v turških morjih (dolžina (cm), teža (g)).***
***Legenda: Sex = spol (M, samec; F, samica; C, oba skupaj; U, neidentificiran); Year = leto vzorčenja; S = sezona vzorčenja (AUT, jesen; WI, zima; SP, pomlad; SU, poletje; C, vse sezone); L = dolžina (TL, celotna dolžina; FL, dolžina razcepa repa; SL, standardna dolžina); a = presečišče (na podlagi virov); b = naklon (iz razmerja $W=aL^b$); $r^2$ = korelacijski koeficient; N = število primerkov; min in max = najmanjše in največje vzorčevalne velikosti (cm); SD = standardni odklon.***
***Vrste so navedene v abecednem redu.***

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Alosa* sp. | Black Sea | C | 1988–94 | C | TL | 0.0081 | 3.103 | 0.921* | 65 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Arnoglossus laterna* | İzmir Bay | C | 1996–97 | C | TL | 0.00932 | 2.897 | 0.940 | 643 | 12.1 | 6.0 | 15.3 | – | Mater & Bayhan (2000) |
| *Argentina sphyraena* | Sigacik trawl area | C | 2003 | C | TL | 0.0062 | 2.93 | 0.93 | 238 | – | 7.5 | 20.7 | – | Filiz & Bilge (2004) |
| *Atherina hepsetus* | Eceabat Dardanelles | C | 1997–99 | C | FL | 0.01287 | 2.890 | 0.999 | 564 | – | 5.8 | 13.0 | – | Altun (2000) |
| *Belone belone* | Black Sea | C | 1988–94 | C | TL | 0.0005 | 3.203 | 0.940* | 65 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Belone belone euxini* | Black Sea | C | 1995–96 | C | TL | 0.00055 | 3.177 | 0.940* | 643 | 37.55 | 31.2 | 52.2 | 0.17 | Samsun (1995) |
| *Capros aper* | Yeşilova Bay | F | 1992 | SU | TL | 0.0000294 | 2.912 | 0.883* | 170 | 86.35 | – | – | 0.7 | Kaya & Ozaydın (1996) |
| *Capros aper* | Yeşilova Bay | M | 1992 | SU | TL | 0.0000204 | 2.915 | 0.883* | 165 | 84.72 | – | – | 0.6 | Kaya & Ozaydın (1996) |
| *Capros aper* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0232 | 2.83 | 0.98 | 455 | – | 2.9 | 10.1 | – | Filiz & Bilge (2004) |
| *Cepola rubescens* | İzmir Bay | F | 1996–97 | C | TL | 0.32388 | 1.269 | 0.792 | 131 | 34.43 | 11.5 | 45.6 | 6.76 | Kaya *et al.* (2001) |
| *Caelorinchus caelorinchus* | Sigacik trawl area | C | 2003 | C | TL | 0.0065 | 2.74 | 0.78 | 208 | – | 4.0 | 21.6 | – | Filiz & Bilge (2004) |
| *Cepola rubescens* | İzmir Bay | M | 1996–97 | C | TL | 0.2154 | 1.384 | 0.810 | 144 | 29.17 | 19.8 | 47.1 | 6.26 | Kaya *et al.* (2001) |
| *Chelidonichthyes lucerna* | İskenderun Bay | F | 1999–00 | C | TL | 0.0095 | 2.990 | 0.960* | 199 | – | 8.0 | 30.3 | – | Ismen *et al.* (2004) |
| *Chelidonichthyes lucerna* | İskenderun Bay | M | 1999–00 | C | TL | 0.0089 | 3.010 | 0.980* | 143 | – | 8.3 | 21.2 | – | Ismen *et al.* (2004) |
| *Chelon labrosus* | Güllük Lagoon | C | 1993–94 | C | TL | 0.0075539 | 3.067 | 0.962* | 45 | 26.4 | 20.0 | 35.0 | 3.5 | Hossucu (2001) |
| *Chlorophthalmus agassizi* | Sigacik trawl area | C | 2003 | C | TL | 0.0027 | 3.37 | 0.98 | 378 | – | 7.7 | 17.5 | – | Filiz & Bilge (2004) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Chimaera monstrosa* | Sigacik trawl area | C | 2003 | C | TL | 0.0028 | 2.82 | 0.98 | 17 | – | 13.1 | 75.3 | – | Filiz & Bilge (2004) |
| *Conger conger* | Sigacik trawl area | C | 2003 | C | TL | 0.0005 | 3.24 | 0.96 | 22 | – | 32.2 | 65.4 | – | Filiz & Bilge (2004) |
| *Dasyatis pastinaca* | İskenderun Bay | F | 1999–00 | C | TL | 0.00091 | 3.440 | 0.940 | 110 | – | 20.5 | 88.0 | – | Ismen (2003) |
| *Dasyatis pastinaca* | İskenderun Bay | M | 1999–00 | C | TL | 0.00237 | 3.170 | 0.950 | 146 | – | 20.0 | 73.0 | – | Ismen (2003) |
| *Dasyatis pastinaca* | İskenderun Bay | C | 1999–00 | C | TL | 0.00144 | 3.310 | 0.940 | 256 | – | 20.0 | 88.0 | – | Ismen (2003) |
| *Dasyatis pastinaca* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0149 | 2.81 | 0.85 | 29 | – | 37.3 | 74.2 | – | Filiz & Bilge (2004) |
| *Dentex dentex* | İskenderun Bay | C | 2000 | AUT | TL | 0.0861 | 2.495 | 0.921 | 16 | 42.41 | 31.40 | 51.0 | 6.35 | Can *et al.* (2000) |
| *Dentex gibbosus* | İskenderun Bay | C | 2000 | AUT | TL | 0.0341 | 2.714 | 0.857 | 34 | 27.29 | 17.68 | 47.3 | 6.83 | Can *et al.* (2000) |
| *Dentex macrophthalmus* | Saros Bay | C | 1991 | SU | TL | 0.01760 | 3.071 | 0.864* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | İzmir Bay | C | 1991 | SU | TL | 0.02248 | 2.966 | 0.889* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Güllük Bay | C | 1991 | SU | TL | 0.00782 | 3.292 | 0.974* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Gökova Bay | C | 1991 | SU | TL | 0.02404 | 2.932 | 0.874* | 60 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Saros Bay | C | 1992 | WI | TL | 0.01974 | 3.027 | 0.988* | 12 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Saros Bay | C | 1992 | SP | TL | 0.00002 | 4.343 | 0.980* | 58 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Gökova Bay | C | 1992 | SP | TL | 0.01280 | 3.107 | 0.970* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Gökova Bay | C | 1993 | SP | TL | 0.01731 | 3.084 | 0986* | 46 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | İzmir Bay | C | 1993 | AUT | TL | 0.02968 | 2.859 | 0.975* | 9 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Güllük Bay | C | 1993 | AUT | TL | 0.02946 | 2.812 | 0.974* | 10 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Gökova Bay | C | 1993 | AUT | TL | 0.02117 | 2.977 | 0.978* | 82 | – | – | – | – | Benli *et al.* (2000) |
| *Dentex macrophthalmus* | Aegean Sea | F | 1991–93 | C | FL | 0.01308 | 3.171 | 0.955* | 285 | 14.10 | 8.2 | 22.0 | 0.18 | Ozaydın (1997) |
| *Dentex macrophthalmus* | Aegean Sea | M | 1991–93 | C | FL | 0.00921 | 3.282 | 0.941* | 203 | 14.65 | 8.2 | 22.0 | 0.37 | Ozaydın (1997) |
| *Dentex macrophthalmus* | Aegean Sea | C | 1991–93 | C | FL | 0.01191 | 3.198 | 0.941* | 507 | 14.23 | 7.8 | 22.0 | 0.20 | Ozaydın (1997) |
| *Dentex macrophthalmus* | Marmara, Aegean and Mediterra-nean Sea | C | 1991–93 | WI | FL | 0.0000099 | 3.143 | 0.962* | 87 | – | 10.7 | 19.5 | – | Anonymus (1993) |
| *Diplodus annularis* | Edremit Bay | F | 1997–98 | C | FL | 0.0367 | 2.797 | 0.865* | 322 | 10.33 | 7.3 | 13.8 | 0.57 | Koc *et al.* (2002) |
| *Diplodus annularis* | Edremit Bay | M | 1997–98 | C | FL | 0.0455 | 2.696 | 0.846* | 330 | 10.18 | 8.0 | 14.0 | 0.55 | Koc *et al.* (2002) |
| *Diplodus annularis* | İzmir Bay | C | 1997–99 | C | FL | 0.014 | 3.190 | – | 160 | – | 7.8 | 15.6 | – | Kınacıgil & Akyol (2001) |
| *Diplodus annularis* | İzmir Bay | F | 1997–99 | C | FL | 0.018 | 3.090 | – | 72 | – | – | – | – | Kınacıgil & Akyol (2001) |
| *Diplodus annularis* | İzmir Bay | M | 1997–99 | C | FL | 0.012 | 3.260 | – | 68 | – | – | – | – | Kınacıgil & Akyol (2001) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Diplodus annularis* | Çandarlı Bay | C | 1992 | WI | TL | 0.04792 | 2.643 | 0.886* | 24 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus annularis* | Güllük Bay | C | 1992 | WI | TL | 0.02056 | 3.016 | 0.957* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus annularis* | Güllük Bay | C | 1993 | SP | TL | 0.02791 | 2.926 | 0.945* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus annularis* | Çandarlı Bay | C | 1993 | AUT | TL | 0.01509 | 3.187 | 0.927* | 36 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus annularis* | İzmir Bay | C | 1993 | AUT | TL | 0.01449 | 3.196 | 0.931* | 32 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus annularis* | Gökova Bay | C | 1993 | AUT | TL | 0.09692 | 2.473 | 0.893* | 18 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus annularis* | Gülbahçe Bay | C | 1996–1997 | C | FL | 0.021 | 3.023 | 0.961 | 205 | | 6.5 | 15.0 | – | Tosunoglu *et al.* (1997) |
| *Diplodus annularis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0000050 | 3.299 | 0.929* | 214 | – | 8.7 | 17.3 | – | Anonymus (1993) |
| *Diplodus annularis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0000248 | 2.959 | 0.895* | 381 | – | 8.4 | 15.4 | – | Anonymus (1993) |
| *Diplodus annularis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000327 | 2.905 | 0.918* | 193 | – | 8.2 | 19.3 | – | Anonymus (1993) |
| *Diplodus annularis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000102 | 3.150 | 0.976* | 104 | – | 9.1 | 16.6 | – | Anonymus (1993) |
| *Diplodus sargus* | İskenderun Bay | C | 2000 | AUT | TL | 0.0342 | 2.807 | 0.850 | 33 | 19.29 | 14.90 | 26.7 | 2.94 | Can *et al.* (2000) |
| *Diplodus vulgaris* | Saros Bay | C | 1992 | WI | TL | 0.02840 | 2.929 | 0.943* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus vulgaris* | İzmir Bay | C | 1993 | AUT | TL | 0.02413 | 2.983 | 0.952* | 35 | – | – | – | – | Benli *et al.* (2000) |
| *Diplodus vulgaris* | İskenderun Bay | C | 2000 | AUT | TL | 0.0131 | 3.124 | 0.933 | 105 | 16.66 | 13.20 | 27.0 | 2.36 | Can *et al.* (2000) |
| *Diplodus vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000334 | 2.929 | 0.943* | 20 | – | 12.1 | 17.5 | – | Anonymus (1993) |
| *Diplodus vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.000365 | 2.908 | 0.992* | 20 | – | 10.5 | 18.9 | – | Anonymus (1993) |
| *Diplodus vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0000680 | 2.795 | 0.984* | 11 | – | 8.8 | 16.7 | – | Anonymus (1993) |
| *Diplodus vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000016 | 3.538 | 0.960* | 18 | – | 13.0 | 18.0 | – | Anonymus (1993) |
| *Dipturus oxyrinnchus* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0007 | 3.40 | 0.99 | 8 | – | 17.9 | 62.2 | – | Filiz & Bilge (2004) |
| *Engraulis encrasicolus* | Eastern Black Sea | C | 2001–02 | WI | SL | 0.032 | 2.507 | 0.895 | 50 | 10.48 | 9.45 | 11.7 | 0.066 | Aka (2003) |
| *Engraulis encrasicolus* | Mid Black Sea | C | 2001–02 | WI | SL | 0.0214 | 2.673 | 0.913 | 50 | 10.04 | 8.75 | 11.35 | 0.088 | Aka (2003) |
| *Engraulis encrasicolus* | Western Black Sea | C | 2001–02 | WI | SL | 0.0111 | 2.979 | 0.865 | 50 | 10.28 | 9.35 | 11.05 | 0.061 | Aka (2003) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Engraulis encrasicolus* | Marmara Sea | C | 2001–02 | WI | SL | 0.0094 | 2.999 | 0.942 | 50 | 11.34 | 10.5 | 12.1 | 0.060 | Aka (2003) |
| *Engraulis encrasicolus* | İzmir Bay | C | 2001–02 | WI | SL | 0.0102 | 2.937 | 0.852 | 50 | 10.34 | 9.5 | 11.2 | 0.049 | Aka (2003) |
| *Engraulis encrasicolus* | Edremit Bay | C | 2001–02 | WI | SL | 0.009 | 2.991 | 0.866 | 50 | 10.14 | 9.15 | 11.45 | 0.062 | Aka (2003) |
| *Engraulis encrasicolus* | Eastern Black Sea | F | 1997–98 | – | TL | 0.0054 | 3.040 | 0.891 | 907 | 11.71 | 8.8 | 13.8 | 3.42 | Gözler & Ciloglu (1998) |
| *Engraulis encrasicolus* | Eastern Black Sea | M | 1997–98 | – | TL | 0.0049 | 3.071 | 0.640 | 339 | 11.68 | 8.8 | 13.8 | 1.74 | Gözler & Ciloglu (1998) |
| *Engraulis encrasicolus* | Eastern Black Sea | C | 1997–98 | – | TL | 0.0057 | 3.015 | 0.855 | 1664 | 11.22 | 7.0 | 13.8 | 4.43 | Gözler & Ciloglu (1998) |
| *Engraulis encrasicolus* | Eastern Black Sea | C | 1996–97 | – | TL | 0.00569 | 3.117 | – | – | – | 6.2 | 13.5 | – | Kayalı (1998) |
| *Engraulis encrasicolus* | Eastern Black sea | C | 1993–94 | – | TL | 0.0051 | 3.048 | – | – | 10.43 | – | – | – | Düzgünes *et al.* (1995) |
| *Engraulis encrasicolus* | Black Sea | C | 1988–94 | C | TL | 0.0053 | 3.038 | 0.941* | 43 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Engraulis encrasicolus* | Black Sea | C | – | – | – | 0.0047 | 3.100 | – | – | – | – | – | – | Ozdamar *et al.* (1991a) |
| *Engraulis encrasicolus* | Black Sea | C | – | – | – | 0.023 | 3.412 | – | – | – | – | – | – | Ozdamar *et al.* (1991b) |
| *Engraulis encrasicolus* | Black Sea | C | – | – | – | 0.0025 | 3.388 | – | – | – | – | – | – | Karacam & Düzgünes (1990) |
| *Engraulis encrasicolus* | Black Sea | C | 1987–88 | – | TL | –2.5941 | 3.386 | – | 956 | 9.34 | 6.66 | 15.25 | – | Düzgünes & Karacam (1989) |
| *Engraulis encrasicolus* | Black Sea | C | 1988–89 | C | TL | 0.00643 | 2.974 | – | 1172 | – | 75 | 130 | – | Unsal (1989)** |
| *Epinephelus costae* | İskenderun Bay | C | 2000 | AUT | TL | 0.0885 | 2.391 | 0.930 | 53 | 29.76 | 14.20 | 55.4 | 8.78 | Can *et al.* (2000) |
| *Gadus euxinus* | Eastern Black Sea | C | – | – | – | 0.0272 | 2.573 | – | – | – | – | – | – | Düzgünes & Karacam (1990) |
| *Gadus merlangus euxinus* | Black Sea | C | 1995–96 | C | TL | 0.0039 | 3.238 | 0.931 | 1302 | 14.53 | 9.0 | 24.0 | 0.07 | Samsun & Erkoyuncu (1998) |
| *Gadus merlangus euxinus* | Black Sea | C | 1988–94 | C | TL | 0.0034 | 3.299 | 0.922* | 54 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Gadus merlangus euxinus* | Mid Black Sea | C | – | C | – | 00043 | 3.195 | – | – | – | – | – | — | Samsun *et al.* (1993) |
| *Gadiculus argenteus argenteus* | Sigacik trawl area | C | 2003 | C | TL | 0.0056 | 3.24 | 0.89 | 110 | – | 6.4 | 10.5 | – | Filiz & Bilge (2004) |
| *Gymnura alatvela* | Sigacik trawl area | C | 2003 | C | TL | 0.0268 | 2.96 | 0.98 | 9 | – | 37.5 | 72.0 | – | Filiz & Bilge (2004) |
| *Helicolenus dactylopterus* | Sigacik trawl area | C | 2003 | C | TL | 0.0079 | 3.28 | 0.92 | 178 | – | 5.5 | 13.5 | – | Filiz & Bilge (2004) |
| *Hoplostethus mediterraneus* | Sigacik trawl area | C | 2003 | C | TL | 0.0149 | 2.95 | 0.98 | 137 | – | 8.0 | 18.0 | – | Filiz & Bilge (2004) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lesueurigobius friessi* | Sigacik trawl area | C | 2003 | C | TL | 0.0392 | 2.13 | 0.72 | 17 | – | 6.2 | 8.1 | – | Filiz & Bilge (2004) |
| *Lepidopus caudatus* | Sigacik trawl area | C | 2003 | C | TL | 0.0004 | 3.11 | 0.99 | 40 | – | 21.9 | 81.5 | – | Filiz & Bilge (2004) |
| *Liza ramada* | Güllük Lagoon | C | 1993–94 | C | TL | 0.0066894 | 3.052 | 0.946* | 86 | 23.5 | 17.0 | 33.8 | 2.8 | Hossucu (2001) |
| *Liza saliens* | Güllük Lagoon | C | 1993–94 | C | TL | 0.008859 | 2.997 | 0.965* | 38 | 25.3 | 18.3 | 39.0 | 3.7 | Hossucu (2001) |
| *Liza saliens* | İzmir Bay | U | 1997–98 | C | FL | 0.0082 | 3.090 | 0.990 | 15 | – | 8.4 | 19.6 | 3.29 | Akyol (1999) |
| *Liza saliens* | İzmir Bay | F | 1997–98 | C | FL | 0.0088 | 3.080 | 0.953 | 294 | – | 13.4 | 33.1 | – | Akyol (1999) |
| *Liza saliens* | İzmir Bay | M | 1997–98 | C | FL | 0.0079 | 3.120 | 0.986 | 121 | – | 13.2 | 28.7 | – | Akyol (1999) |
| *Liza saliens* | İzmir Bay | C | 1997–98 | C | FL | 0.0078 | 3.120 | 0.985 | 430 | – | 8.4 | 33.1 | – | Akyol (1999) |
| *Macroramphosus scolopax* | Sigacik trawl area | C | 2003 | C | TL | 0.0079 | 3.28 | 0.92 | 43 | – | 7.1 | 11.4 | – | Filiz & Bilge (2004) |
| *Merlangius merlangus euxinus* | Black Sea | F | 1990–93 | C | – | 0.0040 | 3.250 | 0.980* | 4176 | – | – | – | – | Işmen (2002) |
| *Merlangius merlangus euxinus* | Black Sea | M | 1990–93 | C | – | 0.0044 | 3.220 | 0.980* | 3181 | – | – | – | – | Işmen (2002) |
| *Merlangius merlangus euxinus* | Eastern Black Sea | F | 1997 | C | – | 0.004856 | 3.151 | – | 1349 | – | – | – | – | Sahin & Akbulut (1997) |
| *Merlangius merlangus euxinus* | Eastern Black Sea | M | 1997 | C | – | 0.005450 | 3.110 | – | 864 | – | – | – | – | Sahin & Akbulut (1997) |
| *Merlangius merlangus euxinus* | Eastern Black Sea | C | 1990 | C | – | 0.0070 | 3.007 | – | – | – | – | – | – | Uysal (1990) |
| *Merluccius merluccius* | Saros Bay | C | 1991 | SU | TL | 0.00669 | 3.013 | 0.736* | 275 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1991 | SU | TL | 0.00933 | 2.617 | 0.64* | 78 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1991 | SU | TL | 0.01038 | 2.862 | 0.674* | 53 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1991 | SU | TL | 0.00732 | 2.977 | 0.681* | 203 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1992 | WI | TL | 0.00382 | 3.221 | 0.960* | 74 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1992 | WI | TL | 0.00507 | 3.097 | 0.986* | 156 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1992 | WI | TL | 0.00383 | 3.188 | 0.995* | 35 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1992 | WI | TL | 0.00573 | 3.025 | 0.997* | 21 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1992 | SP | TL | 0.00297 | 3.164 | 0.960* | 170 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1992 | SP | TL | 0.00572 | 3.029 | 0.941* | 73 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1992 | SP | TL | 0.00670 | 3.101 | 0.980* | 9 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1992 | SP | TL | 0.00570 | 3.050 | 0.960* | 68 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1993 | SP | TL | 0.00297 | 3.075 | 0.970* | 60 | – | – | – | – | Benli *et al.* (2000) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Merluccius merluccius* | Çandarlı Bay | C | 1993 | SP | TL | 0.00561 | 3.069 | 0.991* | 35 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1993 | SP | TL | 0.00665 | 3.037 | 0.903* | 37 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Güllük Bay | C | 1993 | SP | TL | 0.00291 | 3.257 | 0.943* | 17 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1993 | SP | TL | 0.00618 | 3.049 | 0.983* | 51 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1993 | AUT | TL | 0.00642 | 3.028 | 0.997* | 76 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1993 | AUT | TL | 0.00312 | 3.266 | 0.989* | 68 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1993 | AUT | TL | 0.00432 | 3.175 | 0.986* | 58 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Güllük Bay | C | 1993 | AUT | TL | 0.00731 | 3.017 | 0.993* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1993 | AUT | TL | 0.00396 | 3.173 | 0.977* | 26 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1991 | SU | TL | 0.00669 | 3.013 | 0.736* | 275 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1991 | SU | TL | 0.00933 | 2.617 | 0.640* | 78 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1991 | SU | TL | 0.01038 | 2.862 | 0.674* | 53 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1991 | SU | TL | 0.00732 | 2.977 | 0.681* | 203 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1992 | WI | TL | 0.00382 | 3.221 | 0.960* | 74 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1992 | WI | TL | 0.00507 | 3.097 | 0.986* | 156 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1992 | WI | TL | 0.00383 | 3.188 | 0.995* | 35 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1992 | WI | TL | 0.00573 | 3.025 | 0.997* | 21 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1992 | SP | TL | 0.00297 | 3.167 | 0.960* | 170 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1992 | SP | TL | 0.00572 | 3.029 | 0.941* | 73 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1992 | SP | TL | 0.00670 | 3.014 | 0.980* | 9 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1992 | SP | TL | 0.00570 | 3.050 | 0.960* | 68 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1993 | SP | TL | 0.00572 | 3.075 | 0.970* | 60 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1993 | SP | TL | 0.00561 | 3.069 | 0.991* | 35 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1993 | SP | TL | 0.00665 | 3.037 | 0.903* | 37 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Güllük Bay | C | 1993 | SP | TL | 0.00291 | 3.257 | 0.943* | 17 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1993 | SP | TL | 0.00618 | 3.049 | 0.983* | 51 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Saros Bay | C | 1993 | AUT | TL | 0.00642 | 3.028 | 0.977* | 76 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Çandarlı Bay | C | 1993 | AUT | TL | 0.00312 | 3.266 | 0.989* | 68 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | İzmir Bay | C | 1993 | AUT | TL | 0.00432 | 3.175 | 0.983* | 58 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Güllük Bay | C | 1993 | AUT | TL | 0.00731 | 3.017 | 0.993* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Merluccius merluccius* | Gökova Bay | C | 1993 | AUT | TL | 0.00396 | 3.173 | 0.977* | 26 | – | – | – | – | Benli *et al.* (2000) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Merluccius merluccius* | Aegean Sea | C | 1994–95 | C | TL | 0.0045 | 3.194 | 0.974* | 336 | – | 13.6 | 43.5 | – | Uckun *et al.* (2000) |
| *Merluccius merluccius* | Edremit Bay | C | 1996–97 | – | TL | 0.0095 | 2.928 | 0.960* | 165 | – | 15.8 | 37.2 | – | Torcu *et al.* (1997) |
| *Merluccius merluccius* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0000048 | 3.065 | 0.984* | 1164 | – | 10.5 | 69.5 | – | Anonymus (1993) |
| *Merluccius merluccius* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000037 | 3.117 | 0.990* | 1114 | – | 7.8 | 73.5 | – | Anonymus (1993) |
| *Merluccius merluccius* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000043 | 3.090 | 0.988* | 614 | – | 14.2 | 79.0 | – | Anonymus (1993) |
| *Merluccius merluccius* | İzmir Bay | C | 1989 | AUT | FL | 0.00246 | 2.960 | – | 74 | 26.10 | 20.50 | 36.14 | – | Kara & Gurbet (1990) |
| *Mugil cephalus* | Güllük Lagoon | C | 1993–94 | C | TL | 0.008198 | 3.048 | 0.976* | 132 | 31.0 | 17.6 | 46.2 | 6.6 | Hossucu (2001) |
| *Mugil cephalus* | İzmir Bay | U | 1997–98 | C | FL | 0.0149 | 2.950 | 0.998 | 29 | – | 10.2 | 45.3 | – | Akyol (1999) |
| *Mugil cephalus* | İzmir Bay | F | 1997–98 | C | FL | 0.0075 | 3.160 | 0.989 | 98 | – | 25.7 | 54.5 | – | Akyol (1999) |
| *Mugil cephalus* | İzmir Bay | M | 1997–98 | C | FL | 0.0109 | 3.040 | 0.965 | 77 | – | 28.2 | 55.5 | – | Akyol (1999) |
| *Mugil cephalus* | İzmir Bay | C | 1997–98 | C | FL | 0.0101 | 3.070 | 0.991 | 204 | – | 10.2 | 55.5 | – | Akyol (1999) |
| *Mugil so–iuy* | Eastern Black Sea | C | 1995 | C | TL | 0.010 | 2.980 | 0.970* | 174 | – | 22.5 | 68.9 | – | Basçınar & Okumus (1997) |
| *Mugil* sp. | Black Sea | C | 1988–94 | C | TL | 0.0068 | 3.077 | 0.980* | 75 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Mullus barbatus* | İzmir Bay | C | 1997 | WI | FL | 0.0071 | 3.290 | – | 221 | | 10.3 | 19.1 | – | Kınacıgil *et al.* (2001) |
| *Mullus barbatus* | Saroz Bay | C | 1991 | SU | TL | 0.01493 | 2.968 | 0.965* | 222 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Çandarlı Bay | C | 1991 | SU | TL | 0.00775 | 3.234 | 0.918* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | İzmir Bay | C | 1991 | SU | TL | 0.01540 | 2.988 | 0.905* | 118 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Güllük Bay | C | 1991 | SU | TL | 0.02774 | 2.768 | 0.704* | 122 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Gökova Bay | C | 1991 | SU | TL | 0.01578 | 2.998 | 0.857* | 60 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Saroz Bay | C | 1992 | WI | TL | 0.00942 | 3.188 | 0.977* | 80 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Çandarlı Bay | C | 1992 | WI | TL | 0.001261 | 3.067 | 0.973* | 166 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | İzmir Bay | C | 1992 | WI | TL | 0.00871 | 3.204 | 0.980* | 39 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Güllük Bay | C | 1992 | WI | TL | 0.01442 | 3.051 | 0.980* | 53 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Gökova Bay | C | 1992 | WI | TL | 0.00824 | 3.219 | 0.967* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Saroz Bay | C | 1992 | SP | TL | 0.00321 | 3.309 | 0.922* | 170 | – | – | – | – | Benli *et al.* (2000) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Mullus barbatus* | Çandarlı Bay | C | 1992 | SP | TL | 0.00328 | 3.313 | 0.960* | 100 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | İzmir Bay | C | 1992 | SP | TL | 0.00346 | 3.305 | 0.980* | 120 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Güllük Bay | C | 1992 | SP | TL | 0.00110 | 3.051 | 0.941* | 60 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Gökova Bay | C | 1992 | SP | TL | 0.04830 | 2.801 | 0.884* | 11 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Saroz Bay | C | 1993 | SP | TL | 0.01421 | 3.029 | 0.990* | 38 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | İzmir Bay | C | 1993 | SP | TL | 0.01382 | 3.038 | 0.938* | 91 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Güllük Bay | C | 1993 | SP | TL | 0.01205 | 3.115 | 0.981* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Gökova Bay | C | 1993 | SP | TL | 0.00736 | 3.314 | 0.960* | 68 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Saroz Bay | C | 1993 | AUT | TL | 0.03087 | 2.738 | 0.899* | 48 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Çandarlı Bay | C | 1993 | AUT | TL | 0.02738 | 2.824 | 0.963* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | İzmir Bay | C | 1993 | AUT | TL | 0.01723 | 2.984 | 0.902* | 115 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | Gökova Bay | C | 1993 | AUT | TL | 0.00767 | 3.292 | 0.950* | 99 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus barbatus* | İskenderun Bay | C | 1992–93 | C | FL | –1.77494 | 3.026 | 0.956* | 348 | – | 7.5 | 15.12 | – | Türeli & Erdem (1997) |
| *Mullus barbatus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0000033 | 3.320 | 0.960* | 533 | – | 8.5 | 22.4 | – | Anonymus (1993) |
| *Mullus barbatus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000091 | 3.106 | 0.970* | 636 | – | 9.0 | 20.5 | – | Anonymus (1993) |
| *Mullus barbatus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.00000201 | 2.941 | 0.955* | 1084 | – | 8.5 | 21.0 | – | Anonymus (1993) |
| *Mullus barbatus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000078 | 3.143 | 0.968* | 1090 | – | 8.8 | 22.3 | – | Anonymus (1993) |
| *Mullus barbatus* | Mid Black sea | C | – | – | – | 0.0054 | 3.209 | – | – | – | – | – | – | Anonymus (1991a) |
| *Mullus barbatus* | İzmir Bay | C | 1989 | AUT | FL | 0.00542 | 3.344 | – | 231 | 13.30 | 10.83 | 19.50 – | – | Kara & Gurbet (1990) |
| *Mullus barbatus* | Aliağa–Çandarlı Bay | C | 1989 | AUT | FL | 0.13243 | 2.310 | – | 199 | 14.68 | 11.20 | 19.12 | – | Kara & Gurbet (1990) |
| *Mullus barbatus* | Edremit Bay | C | 1989 | AUT | FL | 0.011782 | 2.960 | – | 196 | 15.34 | 11.50 | 18.75 | – | Kara & Gurbet (1990) |
| *Mullus barbatus* | Gülbahçe Bay (İzmir) | C | 1973 | C | FL | 0.0165 | 2.923 | 0.960* | 6054 | – | 7.6 | 22.0 | – | Togulga (1977) |
| *Mullus barbatus* | Edremit Bay | C | 1970 | SU | FL | 0.022 | – | – | 204 | – | 10.0 | 19.0 | – | Kınıkaslan (1972) |
| *Mullus barbatus ponticus* | Eastern Black Sea | F | 1997 | C | – | 0.0052653 | 3.217 | – | – | – | – | – | – | Sahin & Akbulut (1997) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Mullus barbatus ponticus* | Eastern Black Sea | M | 1997 | C | – | 0.0053736 | 3.220 | – | – | – | – | – | – | Sahin & Akbulut (1997) |
| *Mullus barbatus ponticus* | Black Sea | C | 1988–89 | C | TL | 0.006855 | 3.156 | – | 2116 | 12.0 | 6.9 | 25.3 | 0.004 | Samsun & Erkoyuncu (1992) |
| *Mullus surmuletus* | Saros Bay | C | 1991 | SU | TL | 0.0078 | 3.089 | 0.950* | 57 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus surmuletus* | Gökova Bay | C | 1991 | SU | TL | 0.02168 | 2.920 | 0.926* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus surmuletus* | Saros Bay | C | 1992 | WI | TL | 0.03224 | 2.819 | 0.830* | 6 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus surmuletus* | Güllük Bay | C | 1992 | WI | TL | 0.00984 | 3.242 | 0.913* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus surmuletus* | Çandarlı Bay | C | 1992 | SP | TL | 0.00510 | 3.221 | 0.810* | 27 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus surmuletus* | İzmir Bay | C | 1992 | SP | TL | 0.00580 | 3.194 | 0.980 | 28 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus surmuletus* | İzmir Bay | C | 1993 | AUT | TL | 0.01177 | 3.131 | 0.958 | 37 | – | – | – | – | Benli *et al.* (2000) |
| *Mullus surmuletus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0000087 | 3.122 | 0.947* | 170 | – | 11.5 | 32.1 | – | Anonymus (1993) |
| *Mullus surmuletus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0000488 | 2.784 | 0.929* | 131 | – | 114.0 | 205.0 | – | Anonymus (1993) |
| *Mullus surmuletus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000103 | 3.104 | 0.990* | 67 | – | 97.0 | 238.0 | – | Anonymus (1993) |
| *Mullus surmuletus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000209 | 2.971 | 0.968* | 30 | – | 100.0 | 253.0 | – | Anonymus (1993) |
| *Mustelus mustelus* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0011 | 3.25 | 0.99 | 35 | – | 38.3 | 97.5 | – | Filiz & Bilge (2004) |
| *Myliobatis aquila* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0008 | 3.34 | 0.93 | 14 | – | 47.5 | 76.5 | – | Filiz & Bilge (2004) |
| *Oblada melanura* | İskenderun Bay | C | 2000 | AUT | TL | 0.0322 | 2.697 | 0.964 | 22 | 20.45 | 15.60 | 27.0 | 3.32 | Can *et al.* (2000) |
| *Pagellus* sp. | İzmir Bay | C | 1989 | AUT | FL | 0.01592 | 3.008 | – | 111 | 14.59 | 8.66 | 21.43 | – | Kara & Gurbet (1990) |
| *Pagellus* sp. | Edremit Bay | C | 1989 | AUT | FL | 0.14723 | 2.289 | – | 74 | 16.75 | 13.71 | 22.0 | – | Kara & Gurbet (1990) |
| *Pagellus acerna* | Aegean Sea | F | 1991–93 | C | FL | 0.00527 | 3.447 | 0.850* | 85 | 14.74 | 14.7 | 21.0 | 0.34 | Ozaydin (1997) |
| *Pagellus acerna* | Aegean Sea | M | 1991–93 | C | FL | 0.01087 | 3.172 | 0.927* | 139 | 13.68 | 10.5 | 17.8 | 0.22 | Ozaydin (1997) |
| *Pagellus acerna* | Aegean Sea | C | 1991–93 | C | FL | 0.01420 | 3.075 | 0.962* | 302 | 13.27 | 7.8 | 21.0 | 0.24 | Ozaydin (1997) |
| *Pagellus acerna* | Gülbahçe Bay | C | 1996–97 | C | FL | 0.082 | 3.288 | 0.935 | 107 | – | 9.8 | 14.8 | – | Tosunoglu *et al.* (1997) |
| *Pagellus acerna* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000876 | 2.646 | 0.806* | 40 | – | 8.0 | 15.0 | – | Anonymus (1993) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pagellus bogaraveo* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0000018 | 3.472 | 0.951* | 73 | – | 9.0 | 20.0 | – | Anonymus (1993) |
| *Pagellus bogaraveo* | Marmara, Aegean and | C | 1991–93 | SU | FL | 0.0000083 | 3.150 | 0.978* | 5 | – | 11.0 | 15.0 | – | Anonymus (1993) |
| *Pagellus bogaraveo* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000709 | 2.709 | 0.792* | 20 | – | 11.0 | 14.0 | – | Anonymus (1993) |
| *Pagellus bogaraveo* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000061 | 3.214 | 0.968* | 81 | – | 9.0 | 19.0 | – | Anonymus (1993) |
| *Pagrus coeruleostictus* | İskenderun Bay | C | 2000 | AUT | TL | 0.0671 | 2.521 | 0.908 | 311 | 18.52 | 12.50 | 38.8 | 2.93 | Can *et al.* (2000) |
| *Pagellus erythinus* | Saros Bay | C | 1991 | SU | TL | 0.01299 | 2.972 | 0.832* | 124 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Çandarlı Bay | C | 1991 | SU | TL | 0.01190 | 3.156 | 0.959* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | İzmir Bay | C | 1991 | SU | TL | 0.04097 | 2.889 | 0.857* | 60 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Güllük Bay | C | 1991 | SU | TL | 0.01816 | 2.968 | 0.908* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Gökova Bay | C | 1991 | SU | TL | 0.0255 | 2.932 | 0.822* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Saros Bay | C | 1992 | WI | TL | 0.03184 | 2.773 | 0.896* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Çandarlı | C | 1992 | WI | TL | 0.01459 | 3.079 | 0.978* | 29 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Gökova Bay | C | 1992 | WI | TL | 0.01356 | 3.101 | 0.945* | 20 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Saros Bay | C | 1992 | SP | TL | 0.00109 | 3.537 | 0.941* | 46 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Çandarlı Bay | C | 1992 | SP | TL | 0.01619 | 3.011 | 0.960* | 40 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | İzmir Bay | C | 1992 | SP | TL | 0.06402 | 2.752 | 0.960* | 56 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Güllük Bay | C | 1992 | SP | TL | 0.02065 | 2.527 | 0.689* | 42 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Gökova Bay | C | 1992 | SP | TL | 0.04277 | 2.838 | 0.960* | 7 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Saros Bay | C | 1993 | SP | TL | 0.01249 | 3.140 | 0.988* | 16 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | İzmir Bay | C | 1993 | SP | TL | 0.01498 | 3.077 | 0.988* | 57 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Güllük Bay | C | 1993 | SP | TL | 0.06999 | 2.539 | 0.975* | 17 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Gökova Bay | C | 1993 | SP | TL | 0.01754 | 2.993 | 0.956* | 17 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Saros Bay | C | 1993 | AUT | TL | 0.00606 | 3.391 | 0.984* | 17 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Çandarlı Bay | C | 1993 | AUT | TL | 0.06999 | 2.539 | 0.975* | 17 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | İzmir Bay | C | 1993 | AUT | TL | 0.01699 | 3.001 | 0.944* | 57 | – | – | – | – | Benli *et al.* (2000) |
| *Pagellus erythinus* | Aegean Sea | F | 1991–93 | C | FL | 0.02370 | 2.907 | 0.978* | 512 | 15.36 | 11.1 | 24.5 | 0.18 | Ozaydin (1997) |
| *Pagellus erythinus* | Aegean Sea | M | 1991–93 | C | FL | 0.2722 | 2.865 | 0.956* | 163 | 18.27 | 8.8 | 25.6 | 0.41 | Ozaydin (1997) |
| *Pagellus erythinus* | Aegean Sea | C | 1991–93 | C | FL | 0.02423 | 2.985 | 0.972* | 692 | 16.04 | 8.8 | 25.6 | 0.20 | Ozaydin (1997) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pagellus erythinus* | Gülbahçe Bay | C | 1996–97 | C | FL | 0.018 | 3.012 | 0.976 | 204 | – | 8.0 | 24.0 | – | Tosunoğlu *et al.* (1997) |
| *Pagellus erythinus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000287 | 2.917 | 0.966* | 387 | – | 7.0 | 25.0 | – | Anonymus (1993) |
| *Pagellus erythinus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000122 | 3.080 | 0.966* | 117 | | 11.0 | 24.0 | | Anonymus (1993) |
| *Peristedion cataphractum* | Sigacil trawl area | C | 2003 | C | TL | 0.0048 | 2.97 | 0.99 | 11 | – | 8.1 | 21.2 | – | Filiz & Bilge (2004) |
| *Pleuronactes platessa* | Black Sea | C | 1988–94 | C | TL | 0.0078 | 3.109 | 0.960* | 48 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Phycis blennoides* | Sigacik trawl area | C | 2003 | C | TL | 0.0017 | 3.55 | 0.89 | 12 | – | 12.3 | 15.0 | – | Filiz & Bilge (2004) |
| *Pomadasys incisus* | İskenderun Bay | C | 2000 | AUT | TL | 0.0465 | 2.604 | 0.910 | 106 | 16.12 | 13.40 | 21.2 | 1.75 | Can *et al.* (2000) |
| *Pomatomus saltatrix* | Black Sea | C | 1988–94 | C | TL | 0.0388 | 2.558 | 0.846* | 19 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Pomatomus saltator* | İzmir Bay | C | 1987 | AUT –WI | TL | 0.02017 | 2.955 | – | 400 | – | 15.0 | 40.5 | – | Alpbaz & Kınacıgil (1988) |
| *Raja clavata* | Sinop | C | – | – | – | 0.0026 | 3.200 | 0.990 | 54 | – | 27.3 | 83.2 | – | Erdem *et* al. (2001) |
| *Raja clavata* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0016 | 3.30 | 0.94 | 37 | – | 20.5 | 99.0 | – | Filiz & Bilge (2004) |
| *Raja miraletus* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0001 | 4.15 | 0.93 | 13 | – | 30.0 | 50.5 | – | Filiz & Bilge (2004) |
| *Raja* sp. | Black Sea | C | 1988–94 | C | TL | 0.0090 | 2.920 | 0.922* | 40 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Sarda sarda* | Black Sea | C | 1995–96 | AUT –WI | TL | 0.0058 | 3.176 | 0.980* | 4104 | 34.42 | 20.0 | 40.0 | 2.21 | Samsun (1997) |
| *Sarda sarda* | Black Sea | C | 1988–94 | C | TL | 0.0297 | 2.679 | 0.865* | 14 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Sardina pilchardus* | İzmir Bay | F | 1996–97 | C | TL | 0.0053 | 3.275 | 0.872* | 187 | – | 9.3 | 13.0 | – | Karakayıs & Togulga (2000) |
| *Sardina pilchardus* | İzmir Bay | M | 1996–97 | C | TL | 0.0081 | 3.108 | 0.781* | 75 | – | – | – | – | Karakayıs & Togulga (2000) |
| *Sardina pilchardus* | İzmir Bay | C | 1996–97 | C | TL | 0.0062 | 3.214 | 0.855* | 262 | – | 9.3 | 14.6 | – | Karakayıs & Togulga (2000) |
| *Sardina pilchardus* | İzmir Bay | F | 1997–98 | C | FL | 0.0042 | 3.382 | 0.850 | 216 | – | 9.6 | 14.7 | – | Mater & Bayhan (1999) |
| *Sardina pilchardus* | İzmir Bay | M | 1997–98 | C | FL | 0.0025 | 3.600 | 0.870 | 148 | – | 9.8 | 14.9 | – | Mater & Bayhan (1999) |
| *Sardina pilchardus* | İzmir Bay | C | 1997–98 | C | FL | 0.0045 | 3.359 | 0.830 | 364 | – | 9.6 | 14.9 | – | Mater & Bayhan (1999) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Saurida undosquamis* | İskenderun | F | 1999–00 | C | TL | 0.088 | 3.190 | 0.980 | 368 | – | 9.0 | 35.0 | – | Ismen (2002) |
| *Saurida undosquamis* | İskenderun | M | 1999–00 | C | TL | 0.120 | 2.950 | 0.960 | 234 | – | 5.0 | 32.0 | – | Ismen (2002) |
| *Saurida undosquamis* | Fethiye Bay | C | 1993 | C | FL | –1.3279 | 3.295 | 0.828* | 430 | – | 17.3 | 30.8 | – | Mater & Torcu (1997) |
| *Saurida undosquamis* | Mersin Bay | C | 1993 | C | FL | –0.9596 | 2.616 | 0.656* | 100 | – | 13.5 | 32.2 | – | Mater & Torcu (1997) |
| *Saurida undosquamis* | İskenderun Bay | C | 1992–93 | C | FL | –2.06171 | 3.022 | 0.998* | 333 | – | 8.3 | 21.92 | – | Türeli & Erdem (1997) |
| *Scomberomorus commerson* | Güllük and Gökova Bay | C | 1994 | C | TL | 0.1567 | 2.223 | 0.885* | 70 | – | 52.0 | 87.0 | – | Buhan *et al.* (1997) |
| *Scophthalmus maeaticus* | Black Sea | C | – | C | – | 0.0047 | 3.418 | – | – | – | 40.0 | – | – | Erdem (2001) |
| *Scophthalmus maximus* | Eastern Black Sea | F | 1990–91 | C | TL | 0.0099 | 3.140 | 0.980 | 86 | – | 196 | 630 | – | Avsar (1999)** |
| *Scophthalmus maximus* | Eastern Black Sea | M | 1990–91 | C | TL | 0.0112 | 3.110 | 0.980 | 63 | – | 181 | 595 | – | Avsar (1999)** |
| *Scophthalmus maximus* | Eastern Black Sea | C | 1990–91 | C | TL | 0.0085 | 3.180 | 0.980 | 194 | – | 181 | 630 | – | Avsar (1999)** |
| *Scorpaena porcus* | Sinop | C | 1996–97 | – | TL | 0.054 | 2.590 | – | 633 | 17.26 | 11.49 | 23.63 | 0.083 | Koca (2002) |
| *Scorpaena* sp. | Black Sea | C | 1988–94 | C | TL | 0.0180 | 3.080 | 0.980* | 31 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Scyliorhinus canicula* | Northern Aegean Sea | F | 1991–96 | SP | TL | 0.001 | 3.453 | 0.991 | 95 | – | – | 51.7 | – | Cihangir *et al.* (1997) |
| *Scyliorhinus canicula* | Northern Aegean Sea | M | 1991–96 | SP | TL | 0.005 | 2.004 | 0.989 | 121 | – | – | 54.6 | – | Cihangir *et al.* (1997) |
| *Scyliorhinus canicula* | Northern Aegean Sea | C | 1991–96 | SU–AUT | TL | 0.001 | 3.205 | 0.919 | 370 | – | – | 54.6 | | Cihangir *et al.* (1997) |
| *Scyliorhinus canicula* | Siagacik trwal area | C | 2003 | WI, SU | TL | 0.0012 | 3.26 | 0.99 | 637 | – | 10.5 | 50.9 | – | Filiz & Bilge (2004) |
| *Serranus cabrilla* | Edremit Bay | C | 1997–98 | C | FL | 0.0311 | 2.670 | 0.880 | 595 | 14.43 | 8.6 | 22.3 | 1.573 | Torcu *et al.* (2004 |
| *Serranus cabrilla* | Marmara, Aegean and Mediterra-nean Sea | C | 1991–93 | SP | FL | 0.0000225 | 2.879 | 0.937* | 100 | – | 94.0 | 200.0 | – | Anonymus (1993) |
| *Serranus cabrilla* | Marmara, Aegean and Mediterra-nean Sea | C | 1991–93 | SU | FL | 0.0000081 | 3.059 | 0.929* | 193 | – | 94.0 | 255.0 | – | Anonymus (1993) |
| *Serranus cabrilla* | Marmara, Aegean and Mediterra-nean Sea | C | 1991–93 | AUT | FL | 0.0000066 | 3.121 | 0.966* | 176 | – | 10.4 | 20.3 | – | Anonymus (1993) |
| *Serranus cabrilla* | Marmara, Aegean and Mediterra-nean Sea | C | 1991–93 | WI | FL | 0.00001 | 3.043 | 0.980* | 75 | – | 11.6 | 17.5 | – | Anonymus (1993) |
| *Serranus scriba* | Marmara, Aegean and Mediterra-nean Sea | C | 1991–93 | SU | FL | 0.0000252 | 2.878 | 0.719 | 20 | – | 8.0 | 24.0 | – | Anonymus (1993) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Siganus rivulatus* | Antalya Bay | F | 1996–98 | C | TL | 0.0064 | 3.221 | 0.903* | 292 | 15.12 | 7.0 | 21.5 | 0.32 | Bilecenoglu & Kaya (2002) |
| *Siganus rivulatus* | Antalya Bay | M | 1996–98 | C | TL | 0.007945 | 3.135 | 0.903* | 229 | 16.09 | 7.1 | 20.6 | 0.34 | Bilecenoglu & Kaya (2002) |
| *Siganus rivulatus* | Antalya Bay | C | 1996–98 | C | TL | 0.007137 | 3.179 | 0.903* | 521 | – | 7.0 | 21.5 | – | Bilecenoglu & Kaya (2002) |
| *Solea solea* | İskenderun Bay | F | 2000–01 | C | TL | 0.0093 | 3.077 | 0.960 | 530 | – | 20.5 | 28.2 | – | Türkmen (2003) |
| *Solea solea* | İskenderun Bay | M | 2000–01 | C | TL | 0.0117 | 2.998 | 0.973 | 553 | – | 8.8 | 25.0 | – | Türkmen (2003) |
| *Solea* sp. | Black Sea | C | 1988–94 | C | TL | 0.0019 | 3.580 | 0.941* | 19 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Solea solea* | İzmir Bay | C | 1989–90 | C | TL | 0.00514 | 3.135 | 0.815 | 335 | 26.2 | 11.0 | 34.5 | 0.6 | Hossucu (1992) |
| *Solea solea* | İzmir Bay | C | 1989 | AUT | FL | 0.00054 | 3.640 | – | 9 | 23.61 | 22.50 | 25.83 | – | Kara & Gurbet (1990) |
| *Solea solea* | Aliağa–Çandarlı Bay | C | 1989 | AUT | FL | 0.00182 | 3.458 | – | 11 | 25.31 | 20.50 | 30.10 | – | Kara & Gurbet (1990) |
| *Solea solea* | Edremit Bay | C | 1989 | AUT | FL | 0.20137 | 1.951 | – | 14 | 26.21 | 21.50 | 31.00 | – | Kara & Gurbet (1990) |
| *Solea vulgaris* | Yumurtalık | C | 1992–93 | C | TL | –2.52566 | 3.250 | 0.992* | 603 | – | 12.1 | 34.5 | – | Altun *et al.* (1997) |
| *Solea vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0000003 | 3.562 | 0.951* | 8 | – | 23.8 | 34.2 | – | Anonymus (1993) |
| *Solea vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0000026 | 3.183 | 0.937* | 66 | – | 13.9 | 27.4 | – | Anonymus (1993) |
| *Solea vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0001367 | 2.479 | 0.740* | 23 | – | 19.2 | 33.5 | – | Anonymus (1993) |
| *Solea vulgaris* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000098 | 2.958 | 0.960* | 11 | – | – | – | – | Anonymus (1993) |
| *Sparus aurata* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.000025 | 2.941 | 0.960* | 24 | – | 15.5 | 24.1 | – | Anonymus (1993) |
| *Sparus aurata* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0000693 | 2.743 | 0.984* | 9 | – | 15.3 | 22.2 | – | Anonymus (1993) |
| *Sparus aurata* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.000017 | 3.470 | 0.982* | 31 | – | 14.2 | 22.3 | – | Anonymus (1993) |
| *Sparus aurata* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000149 | 3.023 | 0.878* | 14 | – | 16.0 | 19.6 | – | Anonymus (1993) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Sphyraena chrysotaenia* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000053 | 3.049 | 0.895* | 6 | – | 21.0 | 25.2 | – | Anonymus (1993) |
| *Sphyraena chrysotaenia* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.000049 | 3.056 | 0.964* | 22 | – | 14.0 | 25.6 | – | Anonymus (1993) |
| *Sphyraena sphyraena* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0001309 | 2.428 | 0.925* | 9 | – | 24.0 | 34.0 | – | Anonymus (1993) |
| *Sphyraena sphyraena* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0002720 | 2.290 | 0.927* | 13 | – | 22.0 | 35.0 | – | Anonymus (1993) |
| *Spicara flexuosa* | İzmir Bay | F | 1998–99 | C | FL | 0.1156 | 2.163 | 0.689* | 240 | – | 9.20 | 14.90 | – | Mater *et al.* (2001) |
| *Spicara flexuosa* | İzmir Bay | M | 1998–99 | C | FL | 0.0452 | 2.566 | 0.740* | 172 | – | 11.30 | 15.50 | – | Mater *et al.* (2001) |
| *Spicara flexuosa* | İzmir Bay | C | 1998–99 | C | FL | 0.0411 | 2.594 | 0.846* | 412 | – | 9.20 | 15.50 | – | Mater *et al.* (2001) |
| *Spicara smaris* | Eastern Black Sea | F | 1989 | C | TL | 0.0510 | 3.229 | 0.958* | 280 | – | 11.1 | 22.5 | – | Sahin & Genc (1999) |
| *Spicara smaris* | Eastern Black Sea | M | 1989 | C | TL | 0.0650 | 3.126 | 0.880* | 176 | – | 11.3 | 22.0 | – | Sahin & Genc (1999) |
| *Spicara smaris* | Eastern Black Sea | C | 1991–92 | C | TL | 0.005 | 3.260 | – | – | – | – | – | – | Ismen (1995) |
| *Spicara smaris* | Black Sea | C | 1988–94 | C | TL | 0.0061 | 3.215 | 0.941* | 25 | – | – | – | – | Erkoyunucu *et al.* (1994) |
| *Spicara smaris* | Mid Black Sea | C | – | – | – | 0.0051 | 3.217 | – | – | – | – | – | – | Anonymus (1991c) |
| *Sprattus sprattus phallericus* | Eastern Black Sea | F | 1991 | SP–SU | TL | 0.00214 | 3.456 | 0.999* | 214 | – | 8.45 | 14.09 | | Sahin (1999) |
| *Sprattus sprattus phallericus* | Eastern Black Sea | M | 1991 | SP–SU | TL | 0.00204 | 3.474 | 0.994* | 158 | – | 8.27 | 12.5 | – | Sahin (1999) |
| *Sprattus sprattus phallericus* | Eastern Black Sea | C | 1991 | SP–SU | TL | 0.00211 | 3.461 | 0.997* | 372 | – | 8.35 | 13.20 | – | Sahin (1999) |
| *Squalus acanthias* | Black Sea | F | 1969–73 | – | TL | 0.0041 | 3.004 | 0.996 | 1840 | 85 | 30.0 | 140.0 | – | Kutaygil & Bilecik (1998) |
| *Squalus acanthias* | Black Sea | M | 1969–73 | C | TL | 0.0053 | 2.929 | 0.999 | 1780 | 75 | 30.0 | 120.0 | – | Kutaygil & Bilecik (1998) |
| *Squalus acanthias* | Eastern Black Sea | C | 1994–95 | C | TL | 0.0013 | 3.254 | 0.81* | 159 | – | 35.5 | 141.5 | – | Karacam *et al.* (1996) |
| *Squalus acanthias* | Sigacik trawl area | C | 2003 | WI, SU | TL | 0.0031 | 3.11 | 0.98 | 32 | – | 27.0 | 70.5 | – | Filiz & Bigle (2004) |
| *Symphodus tinca* | İskenderun Bay | C | 2000 | AUT | TL | 0.0021 | 3.675 | 0.997 | 10 | 14.41 | 12.10 | 17.2 | 1.75 | Can *et al.* (2000) |
| *Thunnus thynnus* | Aegean and Mediterranean Sea | C | 1996–98 | C | TL | 0.0000181 | 2.988 | 0.994* | 3577 | 118.40 | 59.0 | 275.0 | 37.0 | Karakulak & Oray (2001) |
| *Thunnus thynnus* | Aegean and Mediterranean Sea | C | 1992–94 | C | FL <120 | –21.780 | 0.409 | 0.931 | 145 | – | – | – | – | Karakulak & Oray (1994) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Thunnus thynnus* | Aegean and Mediterranean Sea | C | 1992–94 | C | FL >120 | –186.521 | 1.633 | 0.780 | 1494 | – | – | – | – | Karakulak & Oray (1994) |
| *Torpedo marmorata* | Siagacik trawl area | C | 2003 | WI, SU | TL | 0.0273 | 2.91 | 0.98 | 27 | – | 9.2 | 34.0 | – | Filiz & Bilge (2004) |
| *Trachurus mediterraneus* | Eastern Black Sea | C | 1996–97 | – | TL | 0.0108 | 2.980 | – | – | – | 6.3 | 17.8 | – | Kayalı (1998) |
| *Trachurus mediterraneus* | Mid Black sea | C | – | – | – | 0.0089 | 2.950 | – | – | – | – | – | – | Anonymus (1991b) |
| *Trachurus mediterraneus* | Black Sea | C | – | – | – | 0.3612 | 1.160 | – | – | – | – | – | – | Düzgünes & Karaçam (1991) |
| *Trachurus mediterraneus ponticus* | Black Sea | C | – | – | FL | 0.004834 | 3.218 | – | 601 | – | 6.5 | 17.5 | – | Sahin *et al.* (1997) |
| *Trachurus trachurus* | Mid Black Sea | C | 1995–96 | C | TL | 0.00759 | 3.05 | – | 720 | 14.13 | 9.4 | 16.8 | 0.07 | Yücel & Erkoyuncu (2000) |
| *Trachurus trachurus* | Black Sea | C | 1988–94 | C | TL | 0.0290 | 2.485 | 0.960 | 77 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Trachurus trachurus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0000288 | 3.832 | 0.976* | 259 | – | 9.0 | 29.6 | – | Anonymus (1993) |
| *Trachurus trachurus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000071 | 3.072 | 0.955* | 496 | – | 8.1 | 38.5 | – | Anonymus (1993) |
| *Trachurus trachurus* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000139 | 3.964 | 0.974* | 311 | – | 10.7 | 27.1 | – | Anonymus (1993) |
| *Trigla lucerna* | Yumurtalık | C | 1992–93 | – | TL | –2.18077 | 3.088 | 0.966* | 348 | – | 14.4 | 26.9 | – | Altun *et al.* (1997) |
| *Trigla lucerna* | Black Sea | C | – | – | – | 0.0085 | 3.032 | – | – | – | – | – | – | Erdem *et al.* (1994) |
| *Trigla lucerna* | Black Sea | C | 1988–94 | C | TL | 0.0070 | 3.089 | 0.980* | 55 | – | – | – | – | Erkoyuncu *et al.* (1994) |
| *Trisopterus minutus* | Çandarlı Bay | C | 1993 | SP | TL | 0.0979 | 3.017 | 0.951* | 35 | – | – | – | – | Benli *et al.* (2000) |
| *Trisopterus minutus* | Çandarlı Bay | C | 1993 | AUT | TL | 0.00709 | 3.144 | 0.910* | 117 | – | – | – | – | Benli *et al.* (2000) |
| *Upeneus moluccensis* | Gökova Bay | C | 1993 | AUT | TL | 0.00606 | 3.351 | 0.962* | 39 | – | – | – | – | Benli *et al.* (2000) |
| *Upeneus moluccensis* | Mediterranean Sea | F | 1991–92 | C | FL | 0.01051 | 3.150 | 0.945* | 535 | 13.69 | 8.6 | 17.8 | 1.635 | Kaya *et al.* (1999) |
| *Upeneus moluccensis* | Mediterranean Sea | M | 1991–92 | C | FL | 0.00607 | 3.352 | 0.922* | 176 | 11.16 | 8.5 | 16.1 | 1.378 | Kaya *et al.* (1999) |
| *Upeneus moluccensis* | Fethiye Bay | C | 1990–93 | – | FL | –1.2889 | 3.386 | 0.828* | 536 | – | 9.0 | 17.0 | – | Torcu & Mater (1997) |
| *Upeneus moluccensis* | Mersin Bay | C | 1990–93 | – | FL | –1.0554 | 2.903 | 0.723* | 500 | – | 8.9 | 16.0 | – | Torcu & Mater (1997) |
| *Upeneus moluccensis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SP | FL | 0.0000043 | 3.257 | 0.976* | 152 | – | 81.0 | 167.0 | – | Anonymus (1993) |

| Species | Area | Sex | Year | S | L | a | b | $r^2$ | N | mean | min | max | SD | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Upeneus moluccensis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | SU | FL | 0.0000036 | 3.300 | 0.947* | 300 | – | 93.0 | 176.0 | – | Anonymus (1993) |
| *Upeneus moluccensis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | AUT | FL | 0.0000257 | 2.896 | 0.956* | 207 | – | 86.0 | 178.0 | – | Anonymus (1993) |
| *Upeneus moluccensis* | Marmara, Aegean and Mediterranean Sea | C | 1991–93 | WI | FL | 0.0000027 | 3.353 | 0.941* | 120 | – | 93.0 | 173.0 | – | Anonymus (1993) |
| *Upeneus pori* | Babadillimanı bight | F | 1999–00 | C | TL | 0.0073 | 3.120 | 0.963 | 461 | – | 6.5 | 15.5 | – | Cicek *et al.* (2002) |
| *Upeneus pori* | Babadillimanı bight | M | 1999–00 | C | TL | 0.0103 | 2.976 | 0.949 | 534 | – | 6.3 | 14.7 | – | Cicek *et al.* (2002) |
| *Zosterisessor ophiocephalus* | Izmir Bay | C | 1999–00 | C | TL | 0.0086 | 3.060 | 0.950 | 1066 | – | 8.0 | 23.3 | – | Akyol (2003) |

* r converted into $r^2$

** length–weight relationship corresponding to mm, g

# RAZMERJA MED DOLŽINO IN TEŽO RIB, ŽIVEČIH V TURŠKIH MORJIH: PREGLED

*Hatice TORCU KOÇ & Zeliha AKA ERDOĞAN*
University of Balikesir, Faculty of Science and Arts, Department of Biology, TR-10100 Balikesir, Turkey

*Jakov DULČIĆ*
Inštitut za oceanografijo in ribištvo, HR-21000 Split, P.O. BOX 500, Hrvaška
E-mail: dulcic@izor.hr

*POVZETEK*

*Članek navaja 360 razmerij med dolžino in težo rib, in sicer glede na podatke, ki so bili zbrani iz obstoječe literature in zadevajo 90 vrst iz 40 družin, živečih v turških morjih. Naklon krivulje (b) se je gibal med 0,409 pri vrsti* Thunnus thynnus *in 4,343 pri vrsti* Dentex macrophthalmus. *Povprečna vrednost b je bila 3,088 (± SD = 0,898) in se ni bistveno razlikovala od 3* (t-*test, p <0,05). Mediana koeficienta b je bila 3,062 in 50% vrednosti b se je gibalo med 2,941 in 3,190.*

**Ključne besede:** razmerje med dolžino in težo, ribe, turška morja, pregled

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# ON THE OCCURRENCE OF JOHN DORY *ZEUS FABER* LINNAEUS, 1758 (OSTEICHTHYES: ZEIDAE) IN A PERIMEDITERRANEAN LAGOON: THE TUNIS SOUTHERN LAGOON (NORTHERN TUNISIA)

*Jamila BEN SOUISSI, Hamadi MEJRI & Jeanne ZAOUALI*
Département des Ressources Animales, Halieutiques et des Technologies Agro-alimentaires, Institut National Agronomique de Tunisie, 43 avenue Charles Nicolle, 1082 Tunis, Tunisie

*Amor EL ABED*
Institut des Sciences et Technologies de la Mer, 2025 Salammbô, Tunisie

*Olivier GUÉLORGET & Christian CAPAPÉ*
Laboratoire d'Ichtyologie, case 104, Université Montpellier II, Sciences et Techniques du Languedoc, F-34 095 Montpellier cedex 05, France
E-mail: capape@univ-montp2.fr

## *ABSTRACT*

*As a consequence of environmental restoration, the Tunis Southern Lagoon, which adjoins the Gulf of Tunis was invaded by several teleost species, including John Dory,* Zeus faber *(Linnaeus, 1758), which is the first record of this species in a perimediterranean lagoon. Preliminary data about the diet and feeding habits and mass growth of* Z. faber *in the area are given.*

**Key words:** Osteichthyes, Zeidae, *Zeus faber,* first record, perimediterranean lagoon, Tunis Southern Lagoon

# SEGNALAZIONE DEL PESCE SAN PIETRO *ZEUS FABER* LINNEO, 1758 (OSTEICHTHYES: ZEIDAE) NELLA LAGUNA MERIDIONALE PERIMEDITERRANEA DI TUNISI (TUNISIA SETTENTRIONALE)

*SINTESI*

*Nella laguna meridionale di Tunisi, ai margini del golfo omonimo, dopo un intervento di rinnovo ambientale sono state segnalate diverse specie di pesci ossei. Tra loro anche il Pesce San Pietro* Zeus faber *(Linneo, 1758), individuato per la prima volta in una laguna perimediterranea. Gli autori presentano i primi dati sulla sua alimentazione e sulle sue abitudini alimentari in quest'area e sulla crescita delle sue dimensioni.*

**Parole chiave:** Osteichthyes, Zeidae, *Zeus faber,* primo dato, laguna perimediterranea, laguna meridionale di Tunisi

## INTRODUCTION

The John Dory *Zeus faber* Linnaeus, 1758 is widely distributed in the Atlantic from Norway to Madeira (Quéro, 1986) and southward from the Azores to southern Africa (Blache *et al.*, 1970; Quéro *et al.*, 1981; Séret & Opic, 1990). The species is reported throughout the Mediterranean and also in the western Black Sea (Tortonese, 1970; Quéro, 1986; Fischer *et al.*, 1987). It is commonly captured in Tunisian waters, especially in the Gulf of Tunis (Le Danois, 1925; Gruvel, 1926; Bourgois & Farina, 1961; Maurin, 1962; Ben Mustapha, 1966; Lubet & Azouz, 1969; Azouz, 1974; Bradaï, 2000). During the investigations conducted since 2001 in the close Tunis Southern Lagoon, 65 fish species were collected, including *Z. faber*, recorded for the first time in a perimediterranean lagoon *(sensu* Quignard & Zaouali, 1980, 1981; Quignard *(pers. comm.))*. Several specimens recorded in the area offer an opportunity to present preliminary data on this unusual occurrence in the present article.

## MATERIAL AND METHODS

The Tunis Southern Lagoon adjoins the Gulf of Tunis and formerly covered 1,120 ha, with depths ranging from 0.15 to 1.1 m (average depth of about 0.6 m). As a consequence of an ecological restoration, the surface has been considerably reduced and now covers 720 ha, with a regular depth of about 2.10 m throughout the lagoon, except in restricted areas where it reaches 4 m maximum (Ben Souissi *et al.*, *in press)*. It appears as an elongated ellipse directed SW-NE: 36°17′53.4″ and 36°47′48.0″ N, and 10°12′22.2″ and 10°16′41.4″ E. Its northern border is the navigation channel, which is 10 km long and max. 12 m deep (see Mejri *et al.*, *this issue).*

Investigations were regularly conducted between 2001 and 2004, three times at least per week, and numerous specimens of both teleost and elasmobranch species were examined soon after they were landed by fishermen (Ben Souissi *et al.*, *in press*; Mejri *et al.*, *this issue).* They were mainly caught by gill-nets and trammel nets, occasionally by cast-nests, landing-nets, anglers and diving. Fresh and sometimes alive specimens were examined.

The specimens observed were measured to the nearest millimetre and weighed to the nearest gram. Methods of measurements and counts are given following Tortonese (1970), Quéro *et al.* (1981) and Quéro (1986).

Two indices were used to provide a qualitative study of *Z. faber*:

- vacuity index (VI): number of empty stomachs divided by total number of stomachs multiplied by 100.
- frequency index (FI): number of stomachs, in which a food item was found, expressed as a percentage of total number of examined stomachs.

Tests for significance ($p < 0.05$) were performed by using ANOVA, Student *t*-test and the chi-square test (Legendre & Legendre, 1979; Schwartz, 1986). Total mass *vs.* total length correlations were assessed by least-squares regression.

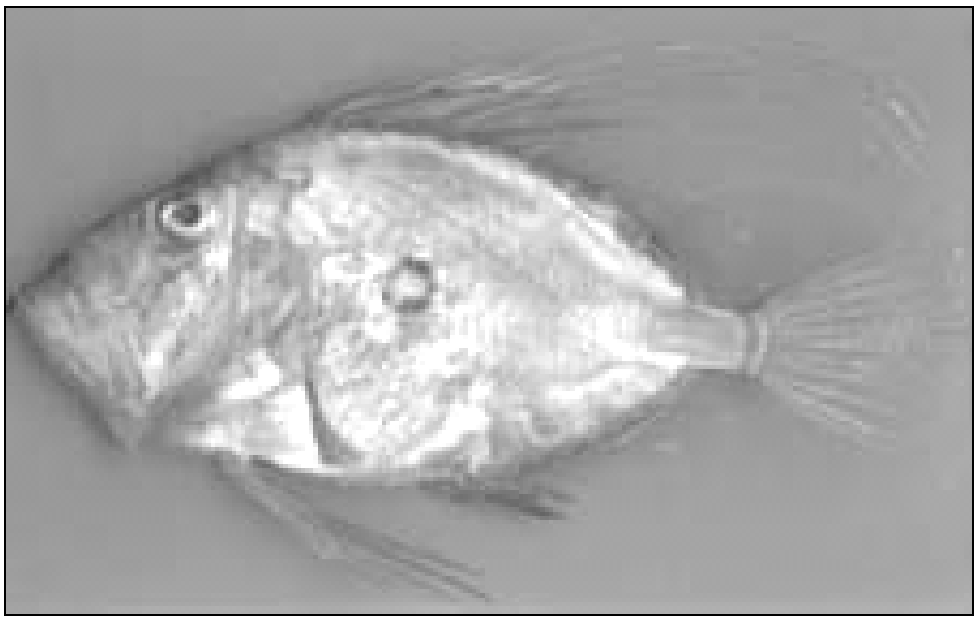

***Fig. 1: John Dory*** *Zeus faber* ***(Linnaeus, 1758) caught in Tunis Southern Lagoon (catalogue number: ZEI–Zef–01).***
***Sl. 1: Kovač*** *Zeus faber* ***(Linné, 1758), ujet v Tuniški južni laguni (kat. št.: ZEI–Zef–01).***

## RESULTS

The first specimen of *Z. faber* was recorded in Tunis Southern Lagoon in January 2002, soon after the environmental restoration in September 2001. The specimen captured on 6 October 2004 is preserved in 5% buffered formalin solution and deposited in the Ichthyological Collection of the Institute of the National Agronomique de Tunisie, catalogue number ZEI–Zef–01 (Fig. 1).

The main morphometric measurements and counts are presented in Table 1, following Dulčić & Pallaoro (2003).

***Tab. 1: Morphometric measurements and counts of** Z. faber**.***
***Tab. 1: Morfometrični in meristični podatki pri vrsti** Z. faber**.***

| **Measurements (mm)** | |
|---|---|
| Total length | 300 |
| Standard length | 224 |
| Head length | 95 |
| Interorbital space | 12 |
| Pre-orbital length | 40 |
| Eye diameter | 21 |
| Caudal fin height | 104 |
| Space between snout and vent | 124 |
| Pectoral fin length | 42 |
| Pectoral fin base | 11 |
| Dorsal fin length | 217 |
| Dorsal fin base | 133 |
| Pelvic fin length | 96 |
| Anal fin length | 49 |
| Anal fin base | 89 |
| Body height | 109 |
| Body depth | 26 |
| Pre-pectoral length | 79 |
| Pre-dorsal length | 87 |
| Pre-anal length | 123 |
| Pre-pelvic length | 62 |
| Distance between dorsal fin and caudal fin origin | 13 |
| Mass in grams | 308 |
| **Counts** | |
| Dorsal fin spines | 10 |
| Dorsal fin soft rays | 23 |
| Pelvic fin spines | 1 |
| Pelvic fin soft rays | 7 |
| Anal fin spines | 4 |
| Anal fin soft rays | 22 |
| Pectoral fin spines | 0 |
| Pectoral fin soft rays | 13 |
| Gill-rakers | 20 |
| Bony bucklers along base of soft dorsal fin | 7 |
| Bony bucklers along base of soft anal fin | 8 |

The Tunisian specimen is described as follows: body oval, deep and strongly compressed; caudal peduncle as long as large; body height 2.06 times in standard length; head deep, dorsal profile convex over eye, its height 2.35 times in standard length; eye rounded rather large, 4.5 times in head height; mouth large and protractile, ending below nostrils close to eye. Pectoral fins short, pelvic fins 2.3 times as long. Body covered with small naked scales. Scutes present along belly. Colour golden grey, with a large black-edged spot on flank; membranes of spinous anal and pelvic fins black, spinous dorsal fin black.

Information provided by fishermen and our observations showed that the species is regularly caught in the area. However, it appears that, to date, captures are more abundant between January and July. They are rather rare during the summer, probably due to the warmer lagoon waters. Estimated captures per day reach 3,650 g maximum and the annual production is assessed to 800 kg.

Forty-two stomach contents of *Z. faber* were analysed with VI = 18.8%, gobids were the most abundant preys (63.8%); mugilid alevins (27.3%), *Atherina boyeri* (9.1%), *Cerastoderma glaucum* and gastropods (both 9%) were also observed. There are no data on the food and feeding habits of *Z. faber* from Tunisian waters. However, Fischer *et al.* (1987) noted that Mediterranean specimens preferentially feed on different teleost species, crustaceans and molluscs.

The relationship total mass (TM) *vs.* total length (TL) is plotted in figure 2. It shows the regular increase of total mass in specimens of less than 260 mm length; however, the larger specimens grew faster. This relation is: TM (g) = 1.531 TL (mm) – 87.592; r = 0.88; n = 42.

## DISCUSSION

All measurements, counts, description and colour agree with Tortonese (1970), Quéro *et al.* (1981) and Quéro (1986). A literature review shows that the John Dory is mostly caught at depths ranging from 20 to 160 m, max. 400 m (Quéro *et al.*, 1981; Quéro, 1986). This may explain why the species has never been recorded in lagoons such as the Tunis Southern Lagoon, whose depth does not exceed four metres. The abundance of the species in the Gulf of Tunis is the source of *Z. faber* in Tunis Southern Lagoon, which is at present submitted to a strong marine influence. By contrast, according to Medhioub & Perthuisot (1977) and Mtimet (2004), *Z. faber* has not been recorded in the Bahiret El Biban, a large hyperhaline lagoon adjoining the Gulf of Gabès, in southern Tunisia, where the species is also very abundant (Bradaï, 2000).

In spite of the interspecific competition pressure for food in this restricted area with other teleost species (see Ben Souissi *et al.*, *in press)* or elasmobranch species

***Fig. 3: John Dory*** *(Zeus faber)* ***(Photo: T. Makovec).***
***Sl. 3: Kovač*** *(Zeus faber)* ***(Foto: T. Makovec).***

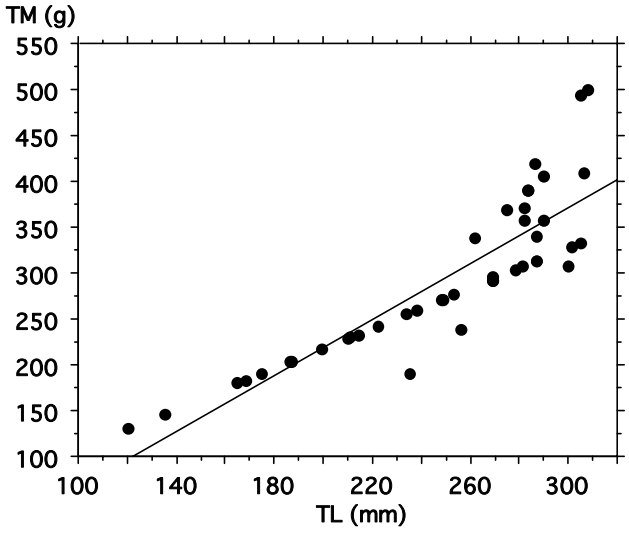


***Fig. 2: Relationship total mass (TM)*** *versus* ***total length (TL) in*** *Z. faber* ***caught in Tunis Southern Lagoon.***
***Sl. 2: Razmerje med skupno maso (TM) in celotno dolžino (TL) pri kovaču, ujetem v Tuniški južni laguni.***

(Mejri *et al., this issue), Z. faber* feeds and develops normally. Furthermore, the irregular captures of *Z. faber* in the area, less abundant in the warm season, do not allow considering it a permanent inhabitant of the area and that a sustainable population will be established in the area. Previously, *Z. faber* had been included among "thalassic species *sensu* Guélorget & Perthuisot (1983, 1992)". This category comprises species entering lagoons only occasionally or turning out accidentally from migratory movements. They develop and reproduce only in offshore areas. They are strictly thalassic species. However, the captures of *Z. faber* in the area are not fortuitous events. By contrast, *Z. faber* is not a sedentary small size species that would be abundantly and regularly caught all year round in lagoons. Moreover, this category of species develops and reproduces only in a confined area. It is a matter of strictly paralic species. A third category concerns species of which fry and juveniles (0+) enter lagoons to find sufficient resources and develop there. These species constitute a mid-term between thalassic and paralic species; they are "mixed species" or, rather, regular migratory species. Sufficient data are still not available to be able to include *Z. faber* in the latter category. The exact status of *Z. faber* in the Tunis Southern Lagoon remains speculative, and further investigations should be carried out in order to define it.

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# O POJAVLJANJU KOVAČA *ZEUS FABER* LINNÉ, 1758 (OSTEICHTHYES: ZEIDAE) V PERIMEDITERANSKI TUNIŠKI JUŽNI LAGUNI (SEVERNA TUNIZIJA)

*Jamila BEN SOUISSI, Hamadi MEJRI & Jeanne ZAOUALI*

Département des Ressources Animales, Halieutiques et des Technologies Agro-alimentaires, Institut National Agronomique de Tunisie, 43 avenue Charles Nicolle, 1082 Tunis, Tunisie

*Amor EL ABED*

Institut des Sciences et Technologies de la Mer, 2025 Salammbô, Tunisie

*Olivier GUÉLORGET & Christian CAPAPÉ*

Laboratoire d'Ichtyologie, case 104, Université Montpellier II, Sciences et Techniques du Languedoc, F-34 095 Montpellier cedex 05, France

E-mail: capape@univ-montp2.fr

*POVZETEK*

*V Tuniški južni laguni, ki meji na Tuniški zaliv, so se po njeni okoljski obnovi znašle številne vrste pravih kostnic, med njimi tudi kovač* Zeus faber *(Linné, 1758), kar je prvi podatek za to vrsto v kaki perimediteranski laguni. Avtorji navajajo preliminarne podatke o prehrani in prehranjevalnih navadah kovača v tem območju in o rasti njegove mase.*

**Ključne besede:** Osteichthyes, Zeidae, *Zeus faber*, prvi podatek, perimediteranska laguna, Tuniška južna laguna

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# ON THE OCCURRENCE OF THE YELLOWMOUTH BARRACUDA, *SPHYRAENA VIRIDENSIS* CUVIER, 1829 (PISCES: SPHYRAENIDAE), IN THE ADRIATIC SEA

*Jakov DULČIĆ & Alen SOLDO*
Institute of Oceanography and Fisheries, HR-21000 Split, P.O. Box 500, Croatia
E-mail: dulcic@izor.hr

## *ABSTRACT*

*The yellowmouth barracuda* Sphyraena viridensis *(three specimens: 456 mm, 432 mm and 515 mm in total length) is reported for the first time from the Adriatic Sea. Morphometric and meristic characteristics are provided.* S. viridensis *must be added to the Adriatic fish fauna, where it overlaps with* S. sphyraena *(and probably with* S. chrysotaenia).

**Key words:** *Sphyraena viridensis*, Sphyraenidae, first record, southern Adriatic

# SEGNALAZIONE DI ESEMPLARI DI LUCCIO MARINO, *SPHYRAENA VIRIDENSIS* CUVIER, 1829, (PISCES: SPHYRAENIDAE) NELL'ADRIATICO

## *SINTESI*

*Gli autori sono i primi a riferire di tre esemplari di luccio di mare* Sphyraena viridensis *(lunghezza totale 456 mm, 432 mm e 515 mm) pescati nell'Adriatico e dei quali sono riportati i dati morfometrici e meristici. La* S. viridensis *va aggiunta all'elenco della fauna ittica dell'Adriatico, dove compare assieme alla specie* S. sphyraena *(e, probabilmente, alla* S. chrysotaenia*).*

**Parole chiave:** *Sphyraena viridensis*, Sphyraenidae, prima segnalazione, Adriatico merdionale

## INTRODUCTION

The updated lists of Mediterranean fish include four species of the genus *Sphyraena*: *sphyraena*, *viridensis*, *chrysotaenia* and *flavicauda* (Tortonese, 1979; Ben-Tuvia, 1986; Fredj & Maurin, 1987; Golani, 1992; Relini & Orsi-Relini, 1997; Golani *et al.*, 2002). In the Adriatic Sea, *Sphyraena sphyraena* (Jardas, 1996) and *Sphyraena chrysotaenia* (Pallaoro & Dulčić, 2001) have been recorded so far. According to Tortonese (1975), *Sphyraena viridensis* is an Atlantic species. Till now, *S. viridensis* has been known to occur in the coastal waters of Israel (Ben-Tuvia, 1971) and Lebanon (George *et al.*, 1971), in the western Mediterranean's northern region (Miniconi *et al.*, 1990; Relini & Orsi-Relini, 1997), Turkish seas (Biszel & Chiangir, 1996), the western Mediterranean's southern region (Ustica Island, Sicily) (Vacchi *et al.*, 1999), Aegean Sea (Corsini & Economidis, 1999), and Algerian coastal waters (Kara & Bourehail, 2003). It has also been reported from the Eastern Central Atlantic (Cape Verde, Canary Islands) and Azores Islands (Barreiros *et al.*, 2002).

The aim of this paper is to present the first record of *S. viridensis* in the Adriatic Sea and therefore to confirm its presence in this part of the Mediterranean.

## MATERIAL AND METHODS

Three specimens of the yellowmouth barracuda *S. viridensis*, caught by professional fishermen with purse seine and small driftnets in July 2004 about 6 Nm off the shore of Hercegnovi (the coast of Serbia and Montenegro) (Fig. 1) at depths between 10 and 15 m, have been obtained recently and accurately identified

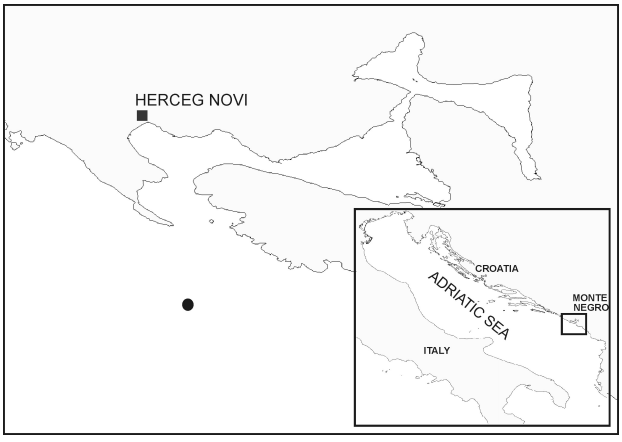


***Fig. 1: Map with location where specimens of the yellowmouth barracuda were caught (Adriatic Sea, Montenegrin coast, 6 Nm off the shore of Hercegnovi).***
***Sl. 1: Zemljevid območja, v katerem so bili ujeti primerki morske ščuke** Sphyraena viridensis **(Jadransko morje, črnogorska obala, 6 Nm od Hercegnovega).***

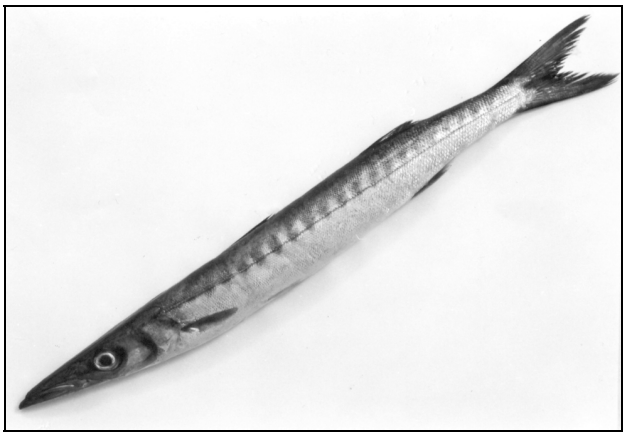

***Fig. 2:** Sphyraena viridensis **(TL=456 mm, W=239 g) caught near Hercegnovi (Montenegrin coast).***
***Sl. 2:** Sphyraena viridensis **(TL=456 mm, W=239 g), ujeta blizu Hercegnovega (črnogorska obala).***

according to Relini & Orsi-Relini (1997) and De Sylva (1990). The specimens are deposited in the private collection of P. Miljanić (Bar, Serbia and Montenegro). This is the first record of this species in the Adriatic Sea. The considered meristic characteristics were dorsal, anal, pectoral and ventral fins, scales in lateral line and scales above the lateral line. The specimens were subsequently measured to the nearest mm, and weighed to the nearest g.

## RESULTS AND DISCUSSION

Table 1 presents the main morphometric and meristic data of the three caught specimens, *i.e.:* specimen 1: TL = 456 mm (W = 239 g) (Fig. 2); specimen 2: TL = 432 mm (W = 209 g) and specimen 3: TL = 515 mm (W = 419 g).

Description of the Adriatic specimens:

body slender, fusiform with conical, hydrodynamic snout. Mouth long, with low protractile capacity and with prognatic lower jaw, has two rows of long canine-like teeth. Has no scale on preoperculum, on both the front and back margins (in *S. sphyraena* the scale covering is continuous). The pelvic fin is inserted below the first dorsal fin, while the tip of pectoral fin does not reach the pelvic fins. The upper half of the body has numerous vertical dark bands extending below the lateral line in the anterior part of the flanks. There is one yellow band parallel to the lateral line. All counts, measurements and descriptions are comparable with those of Relini & Orsi-Relini (1997), Barreiros *et al.* (2002) and Kara & Bourehail (2003). Three main characters, according to Relini & Orsi-Rellini (1997), were used for determination: preoperculum scale pattern, pectoral fin rays (15 in *S. viridensis*, 13 in *S. sphyraena)* and scales above the lateral line (15–17 scales in *S. sphyraena*, 21–22 in *S. viridensis).*

Its habits are probably similar to those of the phylogenetically closely related *S. sphyraena* (De Sylva, 1990). Its exact distribution range and abundance are unknown, as most published records do not separate it from *S. sphyraena*. It feeds on cephalopods, crustaceans and fishes (Ben-Tuvia, 1986). Maximum reported length in this study is 515 mm TL. Maximum recorded length is 1,280 mm (fork length FL) and maximum weight 8,200 g (IGFA, 2001). Relini & Orsi-Relini (1997) reported maximum length TL = 1055 mm and 4400 g in the northern Mediterranean region (deposited in the Genoa Natural History Museum, spm 48808), while George *et al*. (1971) reported maximum length of 820 mm, with mature specimens from 400 mm for the Lebanon coast. P. Miljanić *(pers. comm.),* who saw specimens caught by professional fishermen along the Montenegrin coast, reports on lengths mostly between 450 and 550 mm, even though there are some reports on specimens between 5,000 and 6,000 g. *S. viridensis*, in the opinion of fishermen, is becoming more frequent in the mentioned area and has recently become increasingly popular with underwater photographers. These images give often evidence of its schooling behaviour, as confirmed by Barreiros *et al*. (2002).

Its occurrence in the southern Adriatic confirms the hypothesis that this species has a wider distribution, but it is often confused with the closely related Mediterranean species *S. sphyraena* (Ben-Tuvia, 1986). *S. viridensis* must be added to the Adriatic fish fauna, where it also overlaps with *S. sphyraena* (and probably with *S. chrysotaenia).*

***Tab. 1: Morphometric and meristic data of the yellowmouth barracuda in the southern Adriatic.***
***Tab. 1: Morfometrični in meristični podatki o morski ščuki iz južnega Jadranskega morja.***

| **Morphometric characters (mm)** | **Specimen 1** | **Specimen 2** | **Specimen 3** |
|---|---|---|---|
| Total length (TL) | 456 | 432 | 515 |
| Standard length (SL) | 417 | 368 | 447 |
| Head length (C) | 119 | 109 | 136 |
| Predorsal length 1 (LPD1) | 171 | 165 | 197 |
| Predorsal length 2 (LPD2) | 285 | 278 | 318 |
| Prepectoral length (LPP) | 122 | 118 | 134 |
| Preventral length (LPV) | 183 | 176 | 197 |
| Preanal length (LPA) | 231 | 226 | 234 |
| Max depth | 55 | 54 | 59 |
| Depth D1 | 52 | 49 | 56 |
| Depth D2 | 52 | 51 | 52 |
| Snout-orbit | 64 | 62 | 65 |
| Eye horizontal diameter | 16 | 15 | 17 |
| **Meristic characters** | | | |
| First dorsal fin D1 | 5 | 5 | 5 |
| Second dorsal fin D2 | I/9 | I/9 | I/9 |
| Ventral fin V | I/5 | I/5 | I/5 |
| Anal fin A | I/9 | I/9 | I/9 |
| Pectoral fin P | 15 | 15 | 15 |
| Lateral line LL | 141 | 138 | 151 |
| Scales above lateral line | 21 | 21 | 22 |

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# O POJAVLJANJU MORSKE ŠČUKE, *SPHYRAENA VIRIDENSIS* CUVIER, 1829 (PISCES: SPHYRAENIDAE), V JADRANSKEM MORJU

*Jakov DULČIĆ & Alen SOLDO*

Inštitut za oceanografijo in ribištvo, HR-21000 Split, P.O. Box 500, Hrvaška

E-mail: dulcic@izor.hr

*POVZETEK*

*Avtorja članka kot prva poročata o treh primerkih morske ščuke* Sphyraena viridensis *(celotnih dolžin 456 mm, 432 mm in 515 mm), ujetih v Jadranskem morju ter navajata njihove morfometrične in meristične podatke. Vrsto* S. viridensis *je treba dodati na seznam ribje favne v Jadranu, kjer se prekriva z vrsto* S. sphyraena *(in morebiti tudi z* vrsto S. chrysotaenia*).*

**Ključne besede:** *Sphyraena viridensis*, Sphyraenidae, prvi zapis, južni Jadran

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# *CAREX AUSTROALPINA* BECHERER, A NEW SOUTHEASTERN-ALPINE SPECIES FOR THE FLORA OF SLOVENIA, AND *VIOLA PYRENAICA* RAMOND EX DC., SECOND RECORD FOR THE FLORA OF THE JULIAN ALPS

*Boštjan SURINA*
University of Primorska, Science and Research Centre Koper, SI-6000 Koper, Garibaldijeva 1
E-mail: bostjan.surina@zrs-kp.si

## *ABSTRACT*

Carex austroalpina *(*Carex ferruginea *subsp.* austroalpina*) and* Viola pyrenaica *are reported from the Krn Mts. in the Julian Alps (Southeastern Calcareous Alps).* C. austroalpina*, a southeastern-Alpine species is new for the flora of Slovenia. The two localities in the Krn Mts. are at the easternmost range of their distribution area. The record of* V. pyrenaica *in the Krn Mts. is the second for the flora of Slovenia (the Julian Alps) after nearly half a century. The phytosociological characteristics of the sites are given. Both findings are of significant importance for further phytogeographical assessment of the Southeastern Calcareous Alps.*

**Key words**: flora, *Carex austroalpina, Viola pyrenaica*, phytogeography, Julian Alps, Slovenia

# *CAREX AUSTROALPINA* BECHERER, UNA NUOVA SPECIE ALPINA SUD-ORIENTALE NELLA FLORA SLOVENA, E *VIOLA PYRENAICA* RAMOND EX DC., SECONDA REGISTRAZIONE NELLA FLORA DELLE ALPI GIULIE

## *SINTESI*

*L'autore presenta un resoconto sulle specie* Carex austroalpina *(*Carex ferruginea *subsp.* austroalpina*) e* Viola pyrenaica*, scoperte sul massiccio del Monte Nero (Alpi Giulie, Alpi calcaree sud-orientali). La* C. austroalpina*, specie alpina sud-orientale, è una novità nella flora slovena. Per quanto riguarda la loro diffusione, entrambi i siti si estendono all'estremità orientale del massiccio. Per la flora della Slovenia (Alpi Giulie), è appena la seconda volta che viene individuata la specie* V. pyrenaica*, dopo quasi cinquant'anni. Sono illustrate le caratteristiche fitosociologiche di entrambi i luoghi di crescita. La scoperta è di straordinaria importanza nella prosecuzione del censimento fitogeografico delle Alpi calcaree meridionali.*

**Parole chiave**: flora, *Carex austroalpina, Viola pyrenaica*, fitogeografia, Alpi Giulie, Slovenia

## INTRODUCTION

The phytogeographical peculiarities of the flora and vegetation of the Southeastern Calcareous Alps (Julian Alps, Kamnik Alps and the Karavanke Mountains) have been known to botanists for a long time. In comparison to other Alpine regions they are characterised by a significant number of conservative, progressive, absolute and relative endemic species, southern-, south-eastern-Alpine, north-Illyrian and Illyrian (Illyricoid) species (see Engler, 1901; Mayer, 1946, 1960a, 1960b; Merxmüller, 1952, 1953, 1954; Wraber, 1970a, 1970b, 1995a). According to Pawlowski (1970), the Southeastern Calcareous Alps are floristically the second richest region of the entire Alps. The particularity and originality of its flora are to be attributed to the Alps' specific origin as a result of the historical, geographical and ecological peculiarities of the area. Conservative endemic taxa (*e.g. Campanula zoysii, Cerastium julicum, Cerastium subtriflorum, Festuca laxa, Moehringia villosa, Saxifraga tenella*…), taxonomically clearly isolated and therefore probably dating to the Tertiary period, occur at present in a typical refuge area (*e.g.* Tribsch & Schönswetter, 2003), although the problem of estimating the age or origin of aforementioned species is questionable (for *M. villosa* see Dakskobler, 2000). This is presumably due to the fact that certain parts of the Southeastern Calcareous Alps lay near or even outside the extreme border of glaciation during the Pleistocene period and that these taxa were able to survive in the unglaciated areas or recolonise newly ice-free districts. Other taxonomically isolated and therefore old endemic taxa could include the remnants of the once broader distribution of the same (*e.g. Aquilegia bertolonii, Artemisia atrata*…) or later separated (during the Pleistocene period) ancestor taxa (*e.g.* vicariant taxa *Festuca laxa – F. dimorpha*, *Gentiana froelichii* ssp. *froelichii – G. f.* ssp. *zenariae*, *Gentiana lutea* ssp. *vardjanii – G. l.* ssp. *lutea*…) (see also Wraber, 1990, 1995a). The splitting of the distribution area of originally more widely distributed taxa, which could be purely geographical and/or ecological (silicicolous and calcareous flora), and their subsequent isolation led to numerous endemic taxa. The aim of the paper is to evaluate new findings from the phytosociological and phytogeographical points of view.

## MATERIAL AND METHODS

Floristical and phytosociological research was performed in the Krn Mts., Julian Alps (Southeastern Calcareous Alps). The phytosociological characteristics of the growth sites were established by applying the sigmatistic phytosociological method (Braun-Blanquet, 1964). The nomenclature source for ferns and flowering plants was the Register of the Flora of Slovenia (Trpin & Vreš, 1995) and for syntaxa Feoli Chiapella & Poldini (1993) and Grabherr *et al.* (1993). The collected specimens are stored at the Herbarium of the Scientific Research Centre of Slovenian Academy of Sciences and Arts (ZRC), where the research was carried out.

## RESULTS AND DISCUSSION

### *Carex austroalpina* Becherer

We found *Carex austroalpina (Carex ferruginea* subsp. *austroalpina)* at two localities in the Julian Alps. At the first site (rel. 1, see Appendix), which is located on the southern slope of the Mt. Lemež at 1,730 m a.s.l., it grows in a stand that probably belongs to the association *Centaureetum rhaponticae* s. lat. There are only a few specimens of *C. austroalpina* in the stand.

In the second locality (rel. 2), between the mountains of Veliki and Mali Šmohor at 1,925 m a.s.l., we found a few specimens of *C. austroalpina* in the stand of the association *Ranunculo hybridi-Caricetum sempervirentis*. Because of the phytogeographical position of the southern Julian Alps (especially the Krn and Tolmin-Bohinj Mts.), the finding of *C. austroalpina* in the Krn Mts. is not entirely unexpected. Botanists (*e.g.* E. Mayer and H. Kunz) have actually spent decades searching for the species, but unfortunately with no luck (E. Mayer, *pers. comm.*). The localities on Mt. Lemež and between the Mts. of Veliki and Mali Šmohor are the only known sites as far as the Slovene Calcareous Alps (Fig. 1) are concerned, whereas the species was reported from the westernmost parts of the Julian Alps (see Poldini, 2002).

From the sinsystematical and phytogeographical point of view, the taxon *C. austroalpina* is of great significance for an assessment of the south- and south-eastern subalpine and alpine grasslands *("Seslerio-Semperviretum*" s. lat.). Sutter (1962) treated it as a characteristic and differential species of the alliance *Caricion austroalpinae* (Pignatti & Pignatti, 1975; Feoli Chiapella & Poldini, 1993). The associations of the alliance *Caricion austroalpinae*, which in contrast to the postglacial associations of the alliance *Seslerion coeruleae*, probably survived the glacial area at more or less the same sites in which they can be found today (Pignatti & Pignatti, 1975), include a high number of characteristic, mostly endemic species. The occurrence of *C. austroalpina* in the Krn Mts. (and thus Julian Alps) additionally confirms the placement of these stands in the south-eastern Alpine alliance *Caricion austroalpinae*.

### *Viola pyrenaica* Ramond ex DC.

*Viola pyrenaica* grows on the south-eastern slope of Škrbina pass between Mts. Lemež and Debeljak (the Krn Mts., the Julian Alps), at an altitude of 1,500 m a.s.l. (rel. 3). It is very common in stands of the association *Avenastro parlatorei-Festucetum calvae*.

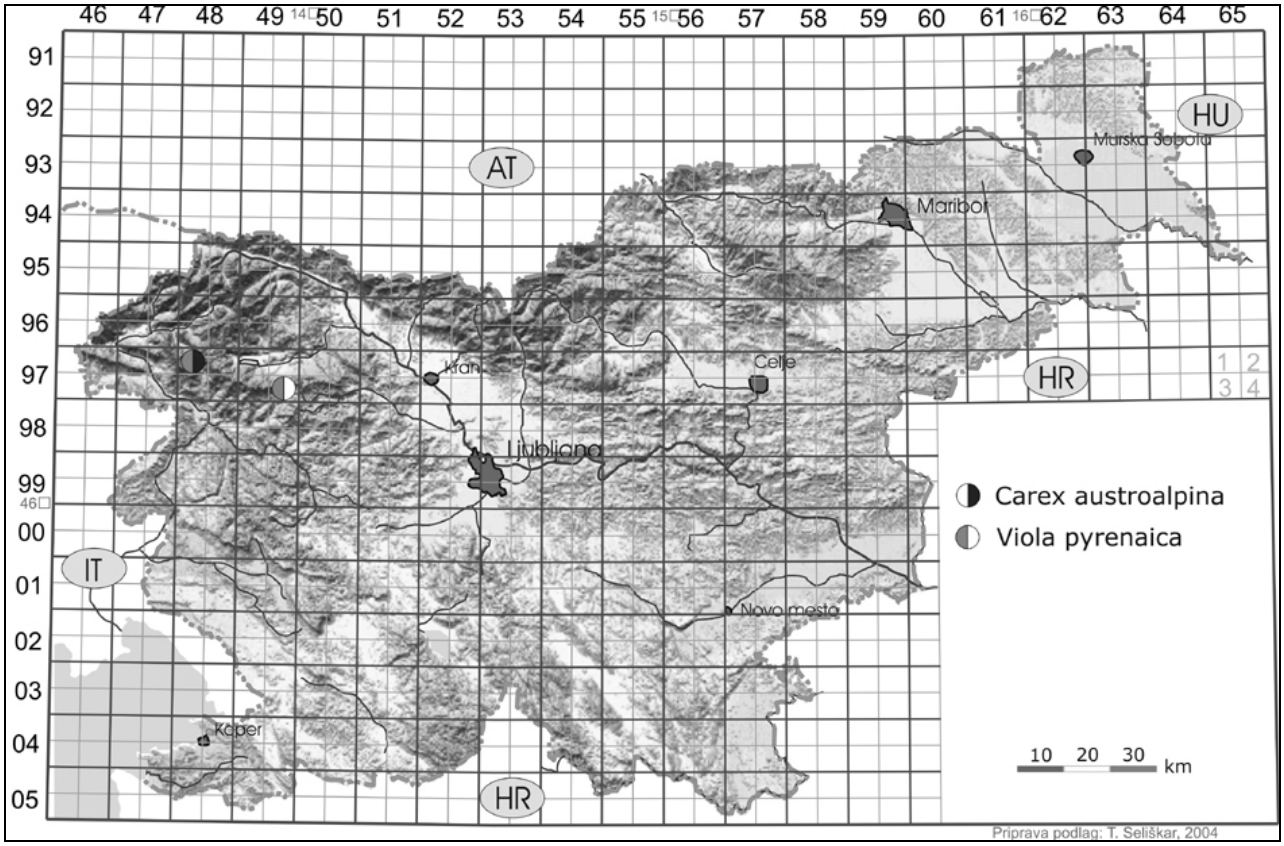


***Fig. 1: Distribution map of** Carex austroalpina **and** Viola pyrenaica **in Slovenia.***
***Sl. 1: Razširjenost vrst** Carex austroalpina **in** Viola pyrenaica **v Sloveniji.***

To date, the locality in the vicinity of Mt. Črna prst (southern ridge of the Julian Alps, MTB: 9749/4) was the only known locality in the Julian Alps (Mayer, 1954). The occurrence of *V. pyrenaica* on the Škrbina pass is the second record for the Julian Alps after nearly half a century. In 2004, Dakskobler (2004, 2005) found some new localities of the species in western Slovenia. In the neighbouring region of Carinthia, botanists have observed it in the valleys of Ziljska dolina (in the vicinity of Šmohor) and Labotska dolina (Mayer, 1954). Its currently known distribution (unpublished data of Dakskobler are not included) in Slovenia is shown in figure 1.

There is a clear indication that not only the flora of the Southeastern Calcareous Alps (*e.g.* the Julian Alps) but also the flora of the southernmost ridge of the Julian Alps itself (the Mt. Breginjski Stol) is of a unique historical and phytogeographical origin (Mayer, 1960b; Wraber, 1970b, 2001). Such an assumption is based on the area of distribution of more than 20 species of various geoelements that occur only on the southernmost ridge of the Julian Alps, some of them also in the Kamnik Alps and the Karavanke Mts. but not (or more sparely) in the central part of the Julian Alps, *e.g. Aconitum angustifolium, Aquilegia bertolonii, Arabis pauciflora, Athamantha turbith, Centaurea haynaldii* subsp. *julica, Cortusa matthioli, Eryngium alpinum, Gentiana froelichii* ssp. *froelichii,*[1] *Gentiana lutea* ssp. *vardjanii, Geranium argenteum, Horminum pyrenaicum, Moehringia villosa, Papaver alpinum* ssp. *victoris, Pedicularis elongata* ssp. *julica, Pimpinella alpina, Primula wulfeniana, Saxifraga exarata* ssp. *atropurpurea, Scorzonera rosea, Stemmacantha rhapontica, Thlaspi kerneri, Trifolium noricum* and others. In the same sense, recent findings of *Viola cornuta* on the Mt. Lemež and its vicinity (the Julian Alps) could be of phytogeographical significance, although its indigenous origin in the Southeastern Calcareous Alps has not been fully proven (Surina & Vreš, 2003; Wraber, 1995b).

**ACKNOWLEDGEMENT**

Dr. Igor Dakskobler (Institute of Biology, Centre of Scientific Research of the Slovenian Academy of Sciences and Arts) kindly reviewed the manuscript and added many useful comments and improvements, while Tomaž Seliškar helped me with the cartographic material. My sincere thanks go to both of them.

[1] In the Julian Alps as *Gentiana froelichii* subsp. *zenariae*.

**Appendix**

Relevé 1

*Locality*: Slovenia, the Julian Alps, the Krn Mts., southern slope of Mt. Lemež; MTB: 9748/1, UTM: UM92, *elevation*: 1,730 m a.s.l.; *exposition*: SE; *inclination*: $25^0$; *releve area*: 25 $m^2$, *herb cover*: 100 %, *leg. et det.*: B. Surina, *date*: 26.6.2002: *Stemmacantha rhapontica* 2, *Achillea distans* 1, *Betonica alopecuros* 1, *Bromus erectus* 1, *Carduus carduelis* 1, *Centaurea triumfettii* 1, *Festuca nigrescens* 1, *Galium lucidum* 1, *Helianthemum grandiflorum* 1, *Koeleria eriostachya* 1, *Lotus corniculatus* 1, *Phleum pratense* 1, *Senecio doronicum* 1, *Acinos alpinus* +, *Aconitum angustifolium* +, *Anthoxanthum odoratum* +, *Anthyllis vulneraria* ssp. *alpestris* +, *Aster alpinus* +, *Buphthalmum salicifolium* +, ***Carex austroalpina*** +, *Carex ferruginea* +, *C. ornithopoda* +, *C. sempervirens* +, *Cerastium strictum* +, *Chaerophyllum villarsii* +, *Dactylis glomerata* +, *Fetsuca calva* +, *Galium anisophyllum* +, *Genista radiata* +, *Heracleum austriacum* ssp. *siifolium* +, *Hippocrepis comosa* +, *Laserpitium peucedanoides* +, *Lathyrus occidentalis* +, *Leucanthemum* cf. *maximum* +, *Lilium carniolicum* +, *Myosotis alpestris* +, *Phyteuma orbiculare* +, *Pimpinella alpina* +, *Potentilla crantzii* +, *Primula veris* ssp. *columnae* +, *Prunella grandiflora* +, *Pulsatilla alpina* +, *Ranunculus nemororsus* +, *Scabiosa lucida* +, *Sesleria albicans* +, *Silene nutans* +, *Thymus alpigenus* +, *Trollius europaeus* +.

Relevé 2

*Localitiy*: Slovenia, the Julian Alps, the Krn Mts., between the Mts. Veliki Šmohor and Mali Šmohor; MTB: 9748/1, UTM: UM92, *elevation*: 1,925 m a.s.l.; *exposition*: SE; *inclination*: $20^0$; *releve area*: 30 $m^2$, *herb cover*: 90 %, *leg. et det.*: B. Surina, *date*: 26.6.2002. *Ranunculo hybridi-Caricetum sempervirentis*: *Carex sempervirens* 5, *Sesleria albicans* 3, *Genista radiata* 2, *Helianthemum grandiflorum* 2, *Erica carnea* 1, *Gentiana clusii* 1, *Helianthemum alpestre* 1, *Hieracium sylvaticum* 1, *H. villosum* 1, *Laserpitium peucedanoides* 1, *Pulsatilla alpina* 1, *Achillea clavenae* +, *Anthyllis vulneraria* ssp. *alpestris* +, *Aposeris foetida* +, *Astrantia bavarica* +, *Bartsia alpina* +, *Betonica alopecuros* +, ***Carex austroalpina*** +, *Carlina acaulis* ssp. *symplex* +, *Galium anisophyllum* +, *Gentiana verna* +, *Gypsophila repens* +, *Heliosperma alpestre* +, *Heracleum austriacum* ssp. *siifolium* +, *Knautia longifolia* +, *Leontopodium alpinum* +, *Lotus corniculatus* +, *Pedicularis rostrato-capitata* +, *Phyteuma orbiculare* +, *Polygala alpestris* +, *Ranunculus hybridus* +, *Saxifraga paniculata* +, *Senecio abrotanifolius* +.

Relevé 3

*Localitiy*: Slovenia, the Julian Alps, the Krn Mts., between the Mts. Debeljak and Lemež; MTB: 9748/1, UTM: UM92, *elevation*: 1,500 m a.s.l.; *exposition*: SE; *inclination*: $20^0$; *releve area*: 25 $m^2$, *herb cover*: 100 %, *leg. et det.*: B. Surina, *date*: 26.6.2002. *Avenastro parlatorei-Festucetum calvae*: *Festuca calva* 4, *Cerastium strictum* 1, *Helianthemum grandiflorum* 1, *Koeleria eriostachya* 1, *Pimpinella alpina* 1, *Primula veris* ssp. *columnae* 1, *Scabiosa lucida* 1, ***Viola pyrenaica*** 1, *Achillea distans* +, *Acinos alpinus* +, *Alchemilla cinerea* +, *A. fallax* +, *Carex digitata* +, *Centaurea triumfettii* +, *Dactylis glomerata* +, *Dianthus sylvestris* +, *Erica carnea* +, *Galium anisophyllum* +, *Galium lucidum* +, *G. sylvaticum* +, *Genista radiata* +, *Gymnadenia odoratissima* +, *Helictotrichon parlatorei* +, *Koeleria pyramidata* +, *Laserpitium siler* +, *Leucanthemum* cf. *maximum* +, *Ligusticum seguieri* +, *Lilium carniolicum* +, *L. martagon* +, *Lotus corniculatus* +, *Luzula luzuloides* +, *Myosotis alpestris* +, *Phleum pratense* +, *Polygonum viviparum* +, *Potentilla crantzii* +, *Prunella grandiflora* +, *Pulsatilla alpina* +, *Sesleria albicans* +, *Stemmacantha rhapontica* +, *Thesium alpinum* +, *Veronica chamaedrys* +.

# *CAREX AUSTROALPINA* BECHERER, NOVA JUGOVZHODNA ALPSKA VRSTA V SLOVENSKI FLORI, IN *VIOLA PYRENAICA* RAMOND EX DC., DRUGI ZAPIS ZA FLORO JULIJSKIH ALP

*Boštjan SURINA*
Univerza na Primorskem, Znanstveno-raziskovalno središče Koper, SI-6000 Koper, Garibaldijeva 1
E-mail: bostjan.surina@zrs-kp.si

*POVZETEK*

*V prispevku avtor podaja fitocenološko oznako rastišč vrst* Carex austroalpina *(*Carex ferruginea *subsp.* austroalpina*) in* Viola pyrenaica *v Krnskem pogorju. Najdba južnoalpskega šaša (*C. austroalpina*) pomeni novo vrsto v flori Slovenije, najdba vrste* V. pyrenaica *pa šele drugo potrditev za Julijske Alpe in Slovenijo.*

*Novi nahajališči južnoalpskega šaša* (C. austroalpina) *na južnem pobočju Lemeža (9748/1, UM92) ter med Velikim in Malim Šmohorjem (9748/1, UM92) sta po današnjem vedenju najbolj proti vzhodu pomaknjeni v južnoalpskem arealu te vrste. Na južnem pobočju Lemeža, na nadmorski višini okrog 1730 m, uspeva v bolj ali manj vlagoljubnem sestoju visokih steblik. Sestoj smo začasno uvrstili v asociacijo* Centaureetum rhaponticae *s. lat. Med Velikim in Malim Šmohorjem smo primerke vrste* C. austroalpina *opazili v sestoju južnoalpskega vednozelenega šašja* (Ranunculo hybridi-Caricetum sempervirentis), *in sicer na nadmorski višini okrog 1925 m. Na obeh nahajališčih so primerki maloštevilni.*

*Pirenejsko vijolico* (V. pyrenaica) *smo opazili na jugovzhodnem pobočju Škrbine med Lemežem in Debeljakom (9748/1, UM92) na nadmorski višini okoli 1500 m. Precej obilno se pojavlja v sestoju asociacije* Avenastro parlatorei-Festucetum calvae. *Rastišče je bolj ali manj toploljubno in je nekakšen naraven sukcesijski prehod od meliščne vegetacije k traviščni.*

*V sintaksonomskem oziru najdbi dodatno potrjujeta pravilnost umeščanja subalpinskih in alpinskih traviščnih asociacij v Jugovzhodnih Apneniških Alpah* (Ranunculo hybridi-Caricetum sempervirentis, Avenastro parlatorei-Festucetum calvae, Centaureo julici-Laserpitietum sileris) *v južnoalpsko zvezo* Caricion austroalpinae, *medtem ko v fitogeografskem oziru prispevata k domnevi, da ima flora južnojulijskega loka (Tolminsko-Bohinjske gore in Krnsko pogorje) v primerjavi s floro osrednjih Julijskih Alp le nekoliko drugačno flornozgodovinsko preteklost.*

**Ključne besede:** flora, *Carex austroalpina, Viola pyrenaica*, fitogeografija, Julijske Alpe, Slovenija

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# HETEROPTERA OF SLOVENIA, II: CIMICOMORPHA I

*Andrej GOGALA*
Slovenian Museum of Natural History, SI-1001 Ljubljana, Prešernova 20, p.p. 290
E-mail: agogala@pms-lj.si

## *ABSTRACT*

*116 species of the infraorder Cimicomorpha without Miridae are listed. Six species were recorded for the very first time in Slovenia:* Derephysia sinuatocollis *Puton, 1879,* Dictyla convergens *(Herrich-Schaeffer, 1835),* Nabis riegeri *Kerzhner, 1996,* Brachysteles parvicornis *(Costa, 1847),* Cardiastethus nazarenus *Reuter, 1884, and* Coranus kerzhneri *Putshkov, 1982. The first reliable record for* Nabis ferus *(Linnaeus, 1758) is also reported. Eight species, listed for Slovenian fauna in different works, are omitted from the list.*

**Key words:** Heteroptera, Cimicomorpha, Tingidae, Microphysidae, Nabidae, Anthocoridae, Cimicidae, Reduviidae, Slovenia, fauna

# HETEROPTERA IN SLOVENIA, II: CIMICOMORPHA I

*SINTESI*

*Sono elencate 116 specie appartenenti all'infraordine Cimicomorpha, esclusa la famiglia Miridae. Sei specie sono state individuate in Slovenia per la prima volta:* Derephysia sinuatocollis *Puton, 1879,* Dictyla convergens *(Herrich-Schaeffer, 1835),* Nabis riegeri *Kerzhner, 1996,* Brachysteles parvicornis *(Costa, 1847),* Cardiastethus nazarenus *Reuter, 1884, e* Coranus kerzhneri *Putshkov, 1982. E' indicato pure il primo dato sicuro relativo alla specie* Nabis ferus *(Linneo, 1758). Otto specie, indicate in varie parti come fauna slovena, sono state escluse dall'elenco.*

**Parole chiave:** Heteroptera, Cimicomorpha, Tingidae, Microphysidae, Nabidae, Anthocoridae, Cimicidae, Reduviidae, Slovenia, fauna

## INTRODUCTION

The fauna of the suborder Heteroptera in Slovenia has been studied from the time of I. A. Scopoli onwards. Although lists of species have been published in the past (Gogala & Gogala, 1986, 1989; Protić, 1998), exact localities are missing in many of them. So I tried to compile as many data as possible, re-examine the material in the collections of the Slovenian Museum of Natural History and publish the results of more recent studies. In this second part of a series of articles I present the list of species of the infraorder Cimicomorpha, without the Miridae, as published or present in the Museum's collections.

The territory of Slovenia was part of several political entities in the past, and many authors were clearly confused when trying to interpret the data published in old works. Let me start with the famous work of Scopoli (1763), *Entomologia carniolica*. The geographical region dealt with in this work is the Austrian province of Carniola or Krain, which is today the western part of Slovenia. Several authors confused it with Carinthia. When the French occupied the territory of Slovenia during the time of Napoleon, they named it Illyria. This name, too, was misinterpreted by several authors. And when Yugoslavia disintegrated some years ago, this caused much confusion yet again. In the Catalogue of the Heteroptera of the Palaearctic Region (Aukema & Rieger, 1996), several records for Croatia were mistakenly attributed to Slovenia, mainly due to the similarity in the names of Slovenia and Slavonia, the Pannonian part of Croatia.

## LIST OF SPECIES

CIMICOMORPHA

**Tingidae**

***Acalypta carinata*** (Panzer, 1806)
*Orthosteira cervina* (Germar, 1837)
Mayr, 1858: Krain (= Kranjska, Carniola), F. Schmidt leg.; Gogala & Moder, 1960: Carniola; Protić, 1998

***Acalypta gracilis*** (Fieber, 1844)
Montandon, 1886: Gorica

***Acalypta marginata*** (Wolff, 1804)
*Orthosteira macrophthalma* Fieber, 1844
Montandon, 1886: Gorica; Gräffe, 1911: Divača; Gogala & Moder, 1960: Bohinj (Sv. Duh); Protić, 1998: Podčetrtek

***Acalypta musci*** (Schrank, 1781)
*Orthosteira cassidea* sensu Fieber, 1844
Fieber, 1844: Illyrien, Krain (= Kranjska, Carniola); Gräffe, 1911: Divača; Gogala & Moder, 1960: Otoče, Carniola; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Carniola, Laibach (= Ljubljana), Golovec, VL69, Stussiner leg.
Carniola, Utik, VM50, 7. 10. 1908, sifted, Stussiner leg.
Carniola, Iauerburg (= Javornik, Jesenice), VM34, sifted, Stussiner leg.
Carn., Haasberger w., Naturbrücken (= Rakov Škocjan), VL47, Stussiner leg.
Kalobje, WM31, 29. 4. 1929, Stussiner leg.
Bohinj: Ukanc, VM02, 26. 7. 1979, A. & M. Gogala leg.
Grad Snežnik, 650 m, from the moss, VL55, 4. 1980, K. Tarman leg.
Želimlje, VL68, 3. 1983, Velkavrh leg.
Karavanke: Železnica, 1570 m, VM15, 25. 7. 1992, S. Brelih leg.
Kočevski Rog: pragozd Pečka, 850 m, VL96, 20. 9. 2001, A. Pirnat leg.
Julijske Alpe: Planica, 880 m, VM04, 29. 4. 1993, S. Brelih leg.
Bela krajina: Metlika, Bušinja vas, WL26, 18. 4. 1996, S. Brelih leg.

***Acalypta nigrina*** (Fallén, 1807)
*Orthosteira cinerea* Fieber, 1844
Mayr, 1858: Krain, F. Schmidt leg.; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 25. 5. 1918, Staudacher leg.
Hrastovlje, VL14, 5. 1978, from the soil, K. Tarman leg.
Dol. Triglav. jezer: Prehodavci, VM03, 13. 7. 1985, A. & M. Gogala leg.
Pohorje: Lovrenška jezera, WM24, 23. 8. 1987, A. & M. Gogala leg.

***Acalypta parvula*** (Fallén, 1807)
Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Kubed, VL14, 1. 2. 1979, moss from the bark, K. Tarman leg.
Matavun, Dol. Sokolak, 375 m, VL25, 11. 10. 2001, A. Pirnat leg.

***Acalypta platycheila*** (Fieber, 1844)
Protić, 1998: Podčetrtek, E. Jaeger leg.

***Agramma atricapillum*** (Spinola, 1837)
Gogala & Gogala, 1986, 1989; Gogala, 1992; Protić, 1998
Specimens examined:
Istra: Sečovlje, Fontanigge, UL93, 24. 10. 1984, M. Gogala leg.
Istra: Koper, Bertoki, Škocjanski zatok, VL04, 11. 8. 2000, A. Gogala leg., 23. 5. 2000, S. Brelih leg.
Nova Gorica, Panovec, UL98, 24. 5. 2000, S. Brelih leg.

***Agramma confusum*** (Puton, 1879)
Montandon, 1886: Gorica (as *Serenthia femoralis);* Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Gogala, 1992; Protić, 1998 (as *A. laetum):* Podčetrtek
Specimens examined:
Carniola, Laibach (= Ljubljana), Stussiner leg.
Laibach (= Ljubljana), 13. 7. 1929, 15. 7. 1929, Staudacher leg.
Vel. Bloke, 2 km E, VL67, 24. 8. 1985, A. & M. Gogala leg.
Bloke: Bloško jezero, VL67, 11. 7. 1987, 10. 9. 1988, 4. 8. 1991, A. & M. Gogala leg.
Bizeljsko, Stara vas, WL59, 21. 4. 2000, A. Gogala leg.

***Agramma minutum*** Horváth, 1874
*Agramma depressa* Jakovlev, 1874
Montandon, 1886: Gorica; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Slavnik, VL14, 2. 6. 1984, A. & M. Gogala leg., 23. 6. 1991, V. Furlan leg.
Loški potok: Retje, VL66, 14. 5. 1990, V. Furlan leg.
Kras: Gorjansko, UL97, 1. 5. 2000, A. & M. Gogala leg.
Istra: Zazid, Zalipnik, VL13, 26. 5. 2000, A. Gogala leg.
Muljava, VL88, 12. 6. 1985, V. Furlan leg.
Črni kal, Socerb, VL14, 8. 5. 1990, V. Furlan leg.
Mozirje, Šmihel, VM93, 15. 8. 1998, V. Furlan leg.

***Agramma ruficorne*** (Germar, 1835)
Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 19. 9. 1928, 21. 9. 1928, Staudacher leg.
Bizeljsko, Stara vas, WL59, 21. 4. 2000, A. Gogala leg.

***Campylosteira orientalis*** Horváth, 1881
Gogala & Moder, 1960 (as *C. sinuata);* Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 29. 9. 1928, 12. 8. 1930, 20. 8. 1930, Staudacher leg.

***Campylosteira verna*** (Fallén, 1826)
Protić, 1998: Podčetrtek, E. Jaeger leg.
Specimens examined:
Prekmurje: Muriša, 160 m, XM25, 10. 4. 1997, S. Brelih leg.

***Catoplatus carthusianus*** (Goeze, 1778)
*Monanthia eryngii* (Latreille, 1804)
Montandon, 1886: Gorica; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Črni kal, VL14, 30. 6. 1979, A. & M. Gogala leg.
Kras: Štorje, VL16, 22. 7. 1980, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 18. 5. 1990, 1. 8. 1990, A. & M. Gogala leg., 16. 5. 1990, 12. 6. 1990, 12. 7. 1990, V. Furlan leg.
Kras: Brje pri Komnu, VL07, 1. 7. 1990, A. & M. Gogala leg.
Kras: Gorjansko, UL97, 15. 7. 1990, 1. 5. 2000, A. & M. Gogala leg.
Hrpelje, Prešnica, VL14, 13. 7. 1998, S. Brelih leg.
Brežec pri Podgorju, VL14, 16. 5. 1990, V. Furlan leg.

***Catoplatus fabricii*** (Stål, 1868)
Montandon, 1886: Gorica (as *Monanthia costata);* Gogala & Moder, 1960: Carniola, Ljubljana, Dobrova, Bled; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998: Podčetrtek
Specimens examined:
Laibach (= Ljubljana), 30. 9. 1928, 20. 5. 1929, 7. 5. 1930, Staudacher leg.
Veldes (= Bled), VM33, 13. 7. 1932, Staudacher leg.
Medvode, Goričane, VM51, 23. 6. 1938, Staudacher leg., 15. 7. 1980, A. & M. Gogala leg.
Ljubljana, Vič, VL59, 19. 4. 1936, Staudacher leg.
Ljubljana, Ježica, VM60, 5. 5. 1935, Staudacher leg.
Ljubljansko barje: Bevke, VL59, 25. 5. 1977, A. & M. Gogala leg.
Škofljica, VL69, 19. 5. 1979, A. & M. Gogala leg.
Ljubljansko barje: Plešivica, VL59, 23. 4. 1978, A. & M. Gogala leg.
Begunje, Visoče, VM43, 1. 5. 1978, A. & M. Gogala leg.
Turjak, VL78, 25. 5. 1980, A. & M. Gogala leg.
Ljubljansko barje: Ig, Kremenica, VL68, 30. 4. 1981, S. Brelih leg., 23. 5. 1998, S. Brelih leg.
Slavnik, VL14, 2. 6. 1984, 23. 6. 1991, A. & M. Gogala leg., 23. 6. 1991, V. Furlan leg.
Ribnica, Rapljevo, VL86, 24. 5. 1986, S. Brelih leg.
Kras: Brje pri Komnu, VL07, 2. 5. 1989, M. Gogala leg.
Bizeljsko, Stara vas, WL59, 21. 4. 2000, A. Gogala leg.
Povir, VL16, 16. 5. 1984, V. Furlan leg.
Ljubljana, Golovec, VL69, 15. 4. 1981, 4. 6. 1982, 3. 5. 1983, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 23. 4. 1983, 15. 5. 1983, 2. 6. 1984, 13. 4. 1985, 21. 4. 1985, 4. 5. 1985, 28. 5. 1985, 10. 4. 1989, 21. 5. 1991, 18. 3. 1998, V. Furlan leg.
Ljubljana, Lavrica, VL69, 29. 4. 1991, 20. 5. 1991, 8. 6. 1991, V. Furlan leg.
Topol, Osredek, VM50, 12. 5. 1985, 11. 5. 1986, 5. 5. 1990, V. Furlan leg.
Topol, Ravnikar, VM50, 9. 6. 1991, V. Furlan leg.
Topol, Sv. Katarina, VM50, 15. 6. 1997, V. Furlan leg.
Muljava, VL88, 11. 5. 1985, 12. 8. 1998, V. Furlan leg.
Muljava, Oslica, VL88, 1. 5. 1991, V. Furlan leg.
Gornji Ig, VL68, 19. 5. 1985, 23. 5. 1987, 14. 5. 1991, V. Furlan leg.
Unec, VL47, 25. 5. 1985, V. Furlan leg.

Bela krajina: Žuniči, WL23, 27. 4. 1983, V. Furlan leg.
Gorjanci: Jugorje, WL16, 27. 4. 1983, V. Furlan leg.
Novo mesto, Trška gora, WL17, 21.-22. 5. 1983, V. Furlan leg.
Suha krajina: Žvirče, VL87, 7. 5. 1983, V. Furlan leg.
Zasavje: Podkum, 740 m, WM00, 24. 5. 1989, V. Furlan leg.
Mali Kum, 813 m, WM00, 6. 5. 1988, V. Furlan leg.
Borovak pri Podkumu, WM00, 9. 5. 1990, V. Furlan leg.
Podkum, Medvedov graben, WM00, 16. 4. 1991, V. Furlan leg.
Ljubljana, Črnuče, Jarški prod, VM60, 27. 5. 1987, 22. 5. 1991, V. Furlan leg.
Sočerga, Mlini, Veli Badin, VL13, 16. 5. 1990, V. Furlan leg.
Črni kal, Socerb, VL14, 8. 5. 1990, V. Furlan leg.
Črni kal, Črnotiče, VL14, 8. 5. 1990, V. Furlan leg.
Loški potok: Retje, VL66, 14. 5. 1990, V. Furlan leg.
Soriška planina, 1500 m, VM22, 26. 6. 1991, V. Furlan leg.
Maribor, Mariborski otok, WM45, 12. 5. 1992, V. Furlan leg.
Ljubljansko barje: Ig, VL69, 5. 7. 1998, V. Furlan leg.

***Catoplatus horvathi*** (Puton, 1878)
Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Slavnik, VL14, 2. 6. 1984, A. & M. Gogala leg., 23. 6. 1991, V. Furlan leg.
Istra: Sočerga, Mlini, Veli Badin, VL13, 16. 5. 1990, V. Furlan leg., 12. 7. 1990, V. Furlan leg., 14. 6. 1991, A. & M. Gogala leg.
Kras: Gorjansko, UL97, 1. 5. 2000, A. & M. Gogala leg.
Istra: Dragonja, Stena, UL93, 6. 5. 2000, A. & M. Gogala leg.

***Catoplatus nigriceps*** Horváth, 1905
*Monanthia melanocephala* sensu Fieber, 1844
Fieber, 1844: Illyrien; Gogala & Gogala, 1989; Protić, 1998
Specimen examined:
Bela krajina: Drašiči, Babna gora, WL25, 13. 8. 1988, M. Štangelj leg.

***Copium clavicorne*** (Linnaeus, 1758)
*Copium cornutum* Thunberg, 1822
Montandon, 1886: Gorica; Gogala & Moder, 1960: Bohinj; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Črni kal, VL14, 5. 8. 1981, 7. 8. 1986, A. & M. Gogala leg.
Istra: Ankaran, VL04, 8. 6. 1983, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 12. 6. 1989, M. Gogala leg., 10. 10. 1999, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 18. 5. 1990, 9. 6. 1990, A. & M. Gogala leg., 16. 5. 1990, 12. 7. 1990, 24. 7. 1990, V. Furlan leg.
Kras: Komen, Vale, UL97, 9. 4. 2000, A. & M. Gogala leg.
Istra: Dragonja, Stena, UL93, 6. 5. 2000, A. & M. Gogala leg.
Sežana, Senadole, VL16, 16. 7. 1996, B. Drovenik leg.
Hrpelje, Prešnica, VL14, 7. 6. 1999, S. Brelih leg.
Istra: Zazid, 380 m, VL14, 26. 5. 2003, S. Brelih leg.
Kras: Lipica, VL15, 30. 5. 1982, V. Furlan leg.

***Copium teucrii*** (Host, 1788)
Gogala & Moder, 1960: Slavnik; Gogala & Gogala, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Črni kal, VL14, 7. 8. 1986, A. & M. Gogala leg.
Bohinj: Ukanc, VM02, 10. 8. 1986, A. & M. Gogala leg.
Istra: Dragonja, Stena, UL93, 30. 8. 1989, 9. 6. 1990, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 3. 10. 1990, A. & M. Gogala leg., 16. 5. 1990, V. Furlan leg.
Slavnik, VL14, 19. 6. 1995, M. Gogala leg., 23. 6. 1991, V. Furlan leg.
Kras: Trstelj, UL98, 15. 8. 1999, A. & M. Gogala leg.
Istra: Zazid, Zalipnik, VL13, 26. 5. 2000, A. Gogala leg.
Hrpelje, Prešnica, VL14, 10. 5. 1999, 23. 5. 1999, S. Brelih leg.

***Corythucha ciliata*** (Say, 1832)
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Ljubljana, VM60, 29. 6. 1978, 8. 4. 1980, A. & M. Gogala leg., 11. 2. 1982, 14. 2. 1982, V. Furlan leg.
Ljubljana: Grad, VM60, 12. 12. 2000, V. Furlan leg.
Istra: Portorož, UL84, 7. 1. 1979, A. & M. Gogala leg.
Vrhnika, VL49, 20. 7. 1988, A. & M. Gogala leg., 22. 1. 2004, A. Gogala leg.
Kras: Dutovlje, VL06, 8. 10. 1989, A. & M. Gogala leg.
Kras: Kozina, Klanec, VL14, 18. 2. 1990, A. & M. Gogala leg.
Vrhnika, Bistra, VL48, 25. 1. 2004, A. & M. Gogala leg.
Ljubljana, Šiška, VM50, 2. 9. 1997, S. Brelih leg.
Šmarješke Toplice, WL17, 20. 4. 1986, V. Furlan leg.

***Derephysia foliacea*** (Fallén, 1807)
Mayr, 1858: Krain, F. Schmidt leg.; Gogala & Moder, 1960: Carniola; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Bohinjska Bistrica, Nemški rovt, VM22, 25. 7. 1979, A. & M. Gogala leg.
Bloke: Bloško jezero, VL67, 7. 8. 1983, A. & M. Gogala leg.
Rovte, VL39, 22. 7. 1983, A. & M. Gogala leg.
Brkini: Barka, VL25, 28. 7. 1984, A. & M. Gogala leg.
Polhograjsko hrib.: Črni vrh, Pasja ravan, VM40, 15. 8. 1984, A. & M. Gogala leg.

Ljubljansko barje: Ig, Kremenica, VL68, 2. 8. 1986, S. Brelih leg.
Kras: Trstelj, UL98, 13. 8. 1989, A. & M. Gogala leg.
Cerkniško jezero: Laze – Otok, VL56, 4. 8. 1991, A. & M. Gogala leg.
Nanos: Sv. Hieronim, VL27, 8. 8. 2000, A. Gogala leg.
Breginj, Bela, UM72, 20. 7. 2000, S. Brelih leg.

***Derephysia sinuatocollis*** Puton, 1879 (Fig. 1)
Specimens examined:
Istra: Popetre, 300 m, VL13, 9. 7. 1997, S. Brelih leg.
Kras: Brje pri Komnu, VL07, 24. 7. 2004 on *Clematis*, A. & M. Gogala leg.

***Fig. 1: The species*** *Derephysia sinuatocollis* ***was very rarely found when its foodplant was not known. It lives in the bark of the*** *Clematis vitalba* ***stems, where it is very numerous.***
***Sl. 1: Vrsta*** *Derephysia sinuatocollis* ***je bila zelo redko najdena, ko njena hranilna rastlina ni bila poznana. Živi v skorji stebel navadnega srobota*** *Clematis vitalba****, kjer je zelo številna.***

***Dictyla convergens*** (Herrich-Schaeffer, 1835)
Specimens examined:
Vinje pri Moravčah, VM71, 23. 5. 1997, A. Gogala leg.
Ljubljansko barje: Iška loka, 292 m, VL69, 25. 10. 1993, S. Brelih leg.

***Dictyla echii*** (Schrank, 1782)
*Monanthia wolffii* Fieber, 1844
Fieber, 1844: Illyrien, F. Schmidt leg.; Fieber, 1861: Illyrien; Mayr, 1858: Krain, F. Schmidt leg.; Montandon, 1886: Gorica; Gogala & Moder, 1960: Carniola, Dobrova, Črnuče, Bohinj, Zagorje; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Zagorje ob Savi, WM00, 14. 7. 1935, Staudacher leg.
Ljubljana, Črnuče, VM60, 2. 7. 1933, Staudacher leg.
Istra: Črni kal, VL14, 1. 7. 1979, A. & M. Gogala leg.
Cerklje na Gor., Sp. post. žič. na Krvavec, VM62, 14. 6. 1981, A. & M. Gogala leg.
Istra: Koštabona, VL03, 25. 6. 1981, M. Gogala leg.
Ljubljansko barje: Iška vas, VL68, 30. 5. 1981, S. Brelih leg.
Kras: Hrpelje, VL15, 2. 7. 1982, A. & M. Gogala leg.
Istra: izvir Rižane, VL14, 18. 3. 1990, A. & M. Gogala leg.
Kras: Brestovica pri Komnu, UL97, 2. 5. 1990, A. & M. Gogala leg.
Istra: Pomjan, VL03, 9. 6. 1990, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 18. 5. 1996, A. & M. Gogala leg.
Istra: Padna, UL93, 1. 2. 1997, A. & M. Gogala leg.
Ljubljana, Črnuče, Jarški prod, VM60, 2. 6. 1998, A. Gogala leg.
Kras: Gorjansko, UL97, 1. 5. 2000, A. & M. Gogala leg.
Črni kal, Socerb, VL14, 8. 5. 1990, V. Furlan leg.
Radeče, Jagnjenica, WM00, 24. 5. 1990, V. Furlan leg.
Ljubljana, Črnuče, Jarški prod, VM60, 22. 5. 1991, 12. 6. 1991, V. Furlan leg.

***Dictyla humuli*** (Fabricius, 1794)
Fieber, 1844: Krain (= Kranjska, Carniola); Montandon, 1886: Gorica; Gogala & Gogala, 1989; Protić, 1998
Specimens examined:
Muljava, Bojanji vrh, VL88, 15. 8. 1985, V. Furlan leg.
Prekmurje: Petišovci, XM15, 13. 6. 1987, A. & M. Gogala leg.
Braniška dol.: Sp. Branica, Čipnje, VL07, 23. 5. 1993, A. & M. Gogala leg.
Bizeljsko, Stara vas, WL59, 21. 4. 2000, A. Gogala leg.
Braniška dol.: Kodreti, Dolanci, VL17, 2. 5. 2000, A. & M. Gogala leg.
Radenci, Hrastje-Mota, WM86, 29. 7. 1998, S. Brelih leg.
Radenci, Rihtarovci, WM86, 9. 8. 1998, S. Brelih leg.
Ljubljana, Vič, VM50, 14. 5. 1997, D. Kofol & S. Gomboc leg.

Nova Gorica, Panovec, UL98, 13. 9. 2000, S. Brelih leg.
Ljubljana, Šmartno, VM60, 4. 5. 1988, V. Furlan leg.
Dol pri Ljubljani, VM70, 20. 5. 1988, V. Furlan leg.
Prekmurje: Renkovci, XM06, 24. 5. 1989, V. Furlan leg.
Sp. Šklendrovec, WM00, 30. 5. 1991, V. Furlan leg.
Ljubljana, Lavrica, VL69, 29. 4. 1991, V. Furlan leg.
Ljubljana, Črnuče, Jarški prod, VM60, 22. 5. 1991, V. Furlan leg.
Ljubljana, Polje, Slape, VM60, 23. 5. 1991, V. Furlan leg.
Kozjansko: Sedlarjevo, WM40, 23. 6. 1993, V. Furlan leg.
Bistrica ob Sotli, WM50, 10. 6. 1993, V. Furlan leg.
Novo mesto, Šmarjeta, WL18, 3. 5. 1997, V. Furlan leg.
Brežice, Terme Čatež, WL48, 23.-28. 4. 1998, V. Furlan leg.
Trnovski gozd: Lokve, VL09, 27. 6. 1998, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 6. 7. 1998, V. Furlan leg.
Novo mesto, Grad Otočec, WL17, 7. 8. 1998, V. Furlan leg.

***Dictyla lupuli*** (Herrich-Schaeffer, 1837)
Fieber, 1844: Illyrien; Mayr, 1858: Krain, F. Schmidt leg.; Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Gogala, 1992; Protić, 1998: Podčetrtek
Specimens examined:
Laibach (= Ljubljana), 30. 9. 1928, 15. 10. 1936, 20. 10. 1937, Staudacher leg.
Rakitna, VL58, 31. 7. 1984, A. & M. Gogala leg.
Novo mesto, Šmarjeta, WL18, 3. 5. 1997, V. Furlan leg.

***Dictyonota strichnocera*** Fieber, 1844
Fieber, 1844: Um Laibach (= near Ljubljana), F. Schmidt leg.: **syntype**; Gogala & Moder, 1960: Carniola; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Črni Kal, VL14, 30. 6. 1979, A. & M. Gogala leg.
Borovnica, Pokojišče, VL48, 7. 9. 1981, A. & M. Gogala leg.
Bloke: Bloško jezero, VL67, 7. 8. 1983, A. & M. Gogala leg.
Polhograjsko hrib.: Črni vrh, Pasja ravan, VM40, 15. 8. 1984, A. & M. Gogala leg.
Kras: Trstelj, UL98, 13. 8. 1989, 1. 7. 2001, A. & M. Gogala leg.
Istra: Pomjan, VL03, 9. 6. 1990, A. & M. Gogala leg.
Istra: Zazid, Golič, 880 m, VL13, 17. 6. 2000, A. Gogala leg.
Planina, Planinsko polje, VL47, 21. 6. 2000, A. Gogala leg.
Istra: Zazid, Lipnik, VL13, 16. 6. 2001, A. Gogala leg.
Otlica, Otliški maj, VL18, 14. 7. 2001, A. Gogala leg.
Cerkniško jezero: Dolenje Jezero, VL56, 7. 8. 2001, A. Gogala leg.
V. Milanja, VL44, 22. 6. 2003, A. Gogala leg.
Istra: Popetre, 300 m, VL13, 9. 7. 1997, S. Brelih leg.
Nanos, 920 m, VL27, 14. 7. 1999, S. Brelih leg.
Loški potok: Retje, VL66, 30. 7. 1998, V. Furlan leg.

***Kalama henschi*** (Puton, 1892)
Gogala & Moder, 1960: Carniola, Bohinj (Sv. Duh); Protić, 1998

***Kalama tricornis*** (Schrank, 1801)
*Dictyonota crassicornis* (Fallén, 1807)
Montandon, 1886: Gorica; Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 20. 9. 1928, Staudacher leg.
Istra: Marezige, VL04, 7. 9. 1985, A. Gogala leg.
Planina, Planinsko polje, VL47, 21. 6. 2000, A. Gogala leg.
Nova Gorica, Panovec, UL98, 13. 9. 2000, S. Brelih leg.
Novo mesto, Trška gora, WL17, 7. 8. 1998, V. Furlan leg.

***Lasiacantha capucina*** (Germar, 1837)
*Lasiacantha capucina piligera* (Garbiglietti, 1869)
Montandon, 1886: Gorica; Gogala & Moder, 1960: Carniola, Ljubljana, Golica; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998: Podčetrtek
Specimens examined:
Styria: Podčetrtek, WM41, 2. 6. 1933, E. Jaeger leg.
Laibach (= Ljubljana), 12. 8. 1930, Staudacher leg.
Dobrova, VM50, A. Moder leg.
Istra: Kubed, VL14, 16. 4. 1988, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 9. 7. 1989, 7. 8. 1989, 7. 9. 1989, 21. 7. 1990, 10. 10. 1999, A. & M. Gogala leg.
Istra: Črnotiče, VL14, 8. 7. 1990, A. & M. Gogala leg.
Istra: Sočerga, Vel. Badin, VL13, 1. 8. 1990, A. & M. Gogala leg.
Braniška dol.: Sp. Branica, Čipnje, VL07, 18. 7. 1991, A. & M. Gogala leg.
Kras: Komen, Vale, UL97, 10. 10. 1999, A. & M. Gogala leg.
Kras: Trstelj, UL98, 25. 6. 2000, A. & M. Gogala leg.
Hrpelje, Prešnica, VL14, 13. 7. 1998, S. Brelih leg.
Čaven: pl. koča, 1240 m, VL18, 27. 5. 1999, S. Brelih leg.
Hrpelje, Prešnica, VL14, 23. 5. 1999, S. Brelih leg.
Julijske Alpe: Krma, VM14, 14. 5. 1983, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 10. 4. 1989, 10. 9. 1998, V. Furlan leg.
Note: The specimen from the Julian Alps is a typical representative of the nominate subspecies, while south Slovenia is populated by the subspecies *piligera*. The population around Ljubljana in central Slovenia is in between, with some specimens resembling more the nominate and other the *piligera* subspecies.

The foodplant of *Lasiacantha capucina piligera* in the Kras (Karst) is *Satureja montana* L.

***Monosteira unicostata*** (Mulsant & Rey, 1852)
Montandon, 1886: Gorica

***Oncochila scapularis*** (Fieber, 1844)
Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Črni kal, VL14, 30. 6. 1979, 28. 6. 1980, A. & M. Gogala leg.
Kras: Štorje, VL16, 22. 7. 1980, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 9. 7. 1989, 21. 7. 1990, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 3. 10. 1990, A. & M. Gogala leg., 12. 7. 1990, V. Furlan leg.
Kras: Trstelj, UL98, 25. 6. 2000, A. & M. Gogala leg.
Braniška dol.: Sp. Branica, Čipnje, VL07, 1. 5. 2001, A. & M. Gogala leg.
Bovec – Kanin, UM83, 23. 7. 2000, S. Brelih leg.
Divača, VL26, 19. 5. 1979, V. Furlan leg.
Slavnik, VL14, 23. 6. 1991, V. Furlan leg.
Novo mesto, Trška gora, WL17, 16. 6. 1991, V. Furlan leg.
Topol, Sv. Katarina, VM50, 9. 6. 1991, V. Furlan leg.

***Oncochila simplex*** (Herrich-Schaeffer, 1830)
Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Carniola, Laibach (= Ljubljana), Stussiner leg.
Prekmurje: Mursko Središće, slov. stran r. Mure, XM15, 6. 7. 1980, A. & M. Gogala leg.
Julijske Alpe: Krma, VM14, 14. 5. 1983, V. Furlan leg.
Brežice, Terme Čatež, WL48, 24. 4. 1998, V. Furlan leg.

***Physatocheila costata*** (Fabricius, 1794)
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Carniola, Laibach (= Ljubljana), Golovec, VL69, Stussiner leg.
Laibach (= Ljubljana), 4. 6. 1940, Staudacher leg.
Ig, Draga, VL68, 19. 8. 1976, S. Brelih leg.
Borovnica, Pokojišče, VL48, 15. 4. 1984, A. & M. Gogala leg.
Gradišče pri Lukovici, VM71, 31. 7. 1996, A. Gogala leg.
Ljubljana, Zadvor, VL69, 30. 4. 1985, V. Furlan leg.

***Physatocheila dumetorum*** (Herrich-Schaeffer, 1838)
Gogala & Moder, 1960: Begunje; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Carniola, Laibach (= Ljubljana), Golovec, VL69, sifted, Stussiner leg.
Polhograjsko hrib.: Črni vrh, VM40, 10. 8. 1983, A. & M. Gogala leg.
Postojna, Landol, VL37, 21. 9. 1983, A. & M. Gogala leg.
Kras: Lipica, VL15, 6. 5. 1984, A. & M. Gogala leg.
Istra: Strunjan, UL94, 16. 10. 1985, A. & M. Gogala leg.
Kras: Kozina, Klanec, VL15, 18. 2. 1990, A. & M. Gogala leg.
Topol, Osredek, VM50, 12. 5. 1985, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 4. 5. 1985, V. Furlan leg.

***Physatocheila harwoodi*** China, 1936
Gogala & Moder, 1960: Ljubljana, Bohinj; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimen examined:
Turjak, VL78, 25. 5. 1980, A. & M. Gogala leg.

***Physatocheila smreczynskii*** China, 1952
Gogala, 1991; Protić, 1998
Specimens examined:
Ljubljana, Zadvor, za Urhom, VL69, 30. 4. 1980, V. Furlan leg.
Ljubljana, Golovec, VL69, 5. 4. 1981, 17. 4. 1982, 19. 4. 1987, V. Furlan leg.

***Stephanitis pyri*** (Fabricius, 1775)
Gogala & Moder, 1960: Šklendrovec; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Šklendrovec, WM00, 18. 9. 1932, Staudacher leg.
Šmarje pri Jelšah, WM42, 17. 8. 1988, A. & M. Gogala leg.
Celje, Šmartinsko jezero, 230 m, WM22, 25. 3. 1995, S. Brelih leg.

***Tingis pilosa*** Hummel, 1825
Gogala & Gogala, 1986, 1989; Protić, 1998: Podčetrtek
Specimens examined:
Laibach (= Ljubljana), 15. 7. 1943, Staudacher leg.
Turjak, VL78, 25. 5. 1980, A. & M. Gogala leg.
Prekmurje: Moravci, WM97, 5. 7. 1980, A. & M. Gogala leg.
Prekmurje: Goričko: Trdkova, WM89, 14. 6. 1987, A. & M. Gogala leg.
Mokronog, Skrovnik, WL19, 3. 5. 1989, S. Brelih leg.
Cerkniško jezero: Zadnji kraj, VL56, 19. 3. 1992, S. Brelih leg.
Prekmurje: Gančani, WM96, 29. 4. 1993, S. Gomboc leg.
Prekmurje: Bukovnica, XM07, 2. 6. 1999, S. Brelih leg.
Ljubljansko barje: Ig, VL69, 4. 7. 1998, V. Furlan leg.
Brežice, Terme Čatež, WL48, 24. 4. 1998, V. Furlan leg.
Ljubljana, Golovec, VL69, 18. 6. 1982, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 21. 5. 1991, V. Furlan leg.
Ljubljana, Šmartno, VM60, 4. 5. 1988, V. Furlan leg.

Ljubljana, Zalog, VM70, 29. 5. 1991, V. Furlan leg.
Senožeče, Gabrče, VL26, 26. 5. 1987, V. Furlan leg.

***Tingis geniculata*** (Fieber, 1844)
Fieber, 1844: Illyrien; Fieber, 1861: Krain

***Tingis maculata*** (Herrich-Schaeffer, 1838)
Gogala & Moder, 1960: Bohinj: Ukanc; Protić, 1998

***Tingis ragusana*** (Fieber, 1861)
Montandon, 1886: Gorica; Gogala, 1991
Specimen examined:
Kum, 1216 m, WM00, 4. 6. 1988, V. Furlan leg.

***Tingis reticulata*** Herrich-Schaeffer, 1835
*Monanthia ciliata* Fieber, 1844
Montandon, 1886: Gorica; Gogala & Moder, 1960: Ljubljana, Dobrova, Vič, Zvirče, Kot; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 29. 9. 1928, 7. 10. 1928, 8. 5. 1929, Staudacher leg.
Ljubljana, Vič, VL59, 19. 4. 1936, Staudacher leg.
Zvoriče (= Zvirče), VM43, 24. 5. 1931, Staudacher leg.
Logatec, VL48, 13. 4. 1980, A. & M. Gogala leg.
Ljubljansko barje: Ig, Kremenica, VL68, 15. 4. 1981, 6. 5. 1981, S. Brelih leg.
Idrija, Krekovše, VL19, 28. 6. 1988, M. Gogala leg.
Vinje pri Moravčah, VM71, 23. 5. 1997, A. Gogala leg.
Kras: Brje pri Komnu, VL07, 26. 4. 2000, 14. 5. 2000, A. & M. Gogala leg.
Ljubljana, Golovec, Orle, VL69, 13. 4. 1985, 21. 4. 1985, 4. 5. 1985, 10. 4. 1989, 21. 5. 1991, 10. 9. 1998, V. Furlan leg.
Ljubljana, Barje, VL69, 10. 5. 1985, V. Furlan leg.
Topol, Osredek, VM50, 12. 5. 1985, 3. 6. 1984, V. Furlan leg.
Gornji Ig, VL68, 19. 5. 1985, V. Furlan leg.
Suha krajina: Žvirče, VL87, 7. 5. 1983, V. Furlan leg.
Bela krajina: Podzemelj, WL25, 28. 4. 1983, V. Furlan leg.
Lipica, VL15, 25. 5. 1985, V. Furlan leg.
Črni kal, Črnotiče, VL14, 8. 5. 1990, V. Furlan leg.
Iška vas, VL68, 3. 5. 1987, V. Furlan leg.
Krka, VL88, 7. 6. 1987, V. Furlan leg.
Ljubljana, Lavrica, VL69, 8. 5. 1991, 29. 4. 1991, 17. 3. 1998, V. Furlan leg.

***Tingis trichonota*** (Puton, 1874)
Reuter, 1888: Gorica

***Tingis ampliata*** (Herrich-Schaeffer, 1838)
Fieber, 1844: Illyrien; Fieber, 1861: Krain

***Tingis angustata*** (Herrich-Schaeffer, 1838)
Fieber, 1844: Illyrien; Fieber, 1861: Krain

***Tingis auriculata*** (Costa, 1847)
*Monanthia sinuata* Fieber, 1844
Fieber, 1844: In Illyrien um Laibach (= near Ljubljana), F. Schmidt leg.: **syntype** of *M. sinuata*; Fieber, 1861: Krain; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Sečovlje, Fontanigge, UL93, 21. 9. 1982, A. & M. Gogala leg., 6. 5. 2000, A. Gogala leg.
Kras: Brje pri Komnu, VL07, 7. 8. 1989, 21. 7. 1990, 10. 10. 1999, 14. 5. 2000, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 9. 6. 1990, A. & M. Gogala leg.
Slavnik, VL14, 19. 6. 1995, M. Gogala leg.
Istra: Gradin, Koromači-Boškini, VL03, 5. 8. 1999, A. & M. Gogala leg.
Istra: Koper, Bertoki, Škocjanski zatok, VL04, 6. 5. 2000, 22. 7. 2000, A. Gogala leg., 23. 5. 2000, S. Brelih leg.
Istra: Boršt, Kozloviči, 260 m, VL03, 9. 7. 1997, S. Brelih leg.
Dragonja, UL93, 4. 5. 2000, S. Brelih leg.

***Tingis cardui*** (Linnaeus, 1758)
Montandon, 1886: Gorica; Gogala & Moder, 1960: Črnomelj, Golica; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Brkini: Barka, VL25, 28. 7. 1984, A. & M. Gogala leg.
Istra: Sočerga, Mlini, Veli Badin, VL13, 16. 5. 1990, V. Furlan leg., 12. 7. 1990, V. Furlan leg.
Postojna, VL37, 10. 6. 1991, V. Furlan leg.
Kras: Kozina, VL15, 22. 6. 1991, V. Furlan leg.
Hrpelje, Prešnica, VL14, 23. 5. 1999, S. Brelih leg.

***Tingis crispata*** (Herrich-Schaeffer, 1838)
Péricart, 1983
Specimens examined:
Braniška dolina: Kodreti, Dolanci, VL17, 2. 5. 2000, A. & M. Gogala leg.
Brežice, Terme Čatež, WL48, 28. 4. 1998, V. Furlan leg.

**Microphysidae**

***Loricula elegantula*** (Baerensprung, 1858)
Floren & Gogala, 2002
Specimens examined:
Gradišče pri Lukovici, VM71, 12. 6. 1996, A. Gogala leg.
Kočevski Rog, Baza 20, 900 m, WL06, 25. 6. 1999, 26. 6. 1999, 28. 6. 1999, A. Floren leg.

**Nabidae**

***Alloeorhynchus flavipes*** (Fieber, 1836)
Reuter, 1888: Gorica

***Prostemma aeneicolle*** Stein, 1857
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Sorško polje, VM51, 4. 1918, M. Hafner leg.
Ljubljana, Tacen, VM50, 6. 3. 1983, A. & M. Gogala leg.
Ljubljansko barje: Log pri Brezovici, VL59, 7. 9. 1986, A. & M. Gogala leg.
Kras: Klanec pri Kozini, VL14, 22. 5. 1991, A. Gogala leg.
Ig, Kurešček, VL68, 2. 5. 1999, A. & M. Gogala leg.
Ljubljana, Kleče, VM60, 22. 3. 2000, A. & M. Gogala leg.
Istra: Podgorje, Golič, 800 m, VL13, 11. 5. 2002, A. & M. Gogala leg.
Vel. Lašče, Uzmani, VL67, 23. 4. 2004, S. Brelih leg.
Golovec: Orle, VL69, 23. 5. 1999, V. Furlan leg.

***Prostemma guttula*** (Fabricius, 1787)
Gräffe, 1911: Görz (= Gorica); Gogala, 1991; Protić, 1998
Specimens examined:
Kras: Vojščica, UL97, 6. 5. 1989, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 1. 4. 1990, A. & M. Gogala leg.
Istra: Dragonja, Stena, UL93, 30. 7. 1995, A. & M. Gogala leg.
Istra: Padna, UL93, 1. 2. 1997, A. & M. Gogala leg.

***Prostemma sanguineum*** (Rossi, 1790)
Gräffe, 1911: Görz (= Gorica)

***Himacerus major*** (Costa, 1842)
Gogala *et al.*, 1990; Gogala, 1991, 1992; Gogala & Gogala, 1994; Protić, 1998
Specimens examined:
Istra: Dragonja, Stena, UL93, 17. 9. 1989, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 1. 8. 1990, A. & M. Gogala leg.
Istra: Sečovlje, Fontanigge, UL93, 18. 9. 2003, A. Gogala leg.

***Himacerus mirmicoides*** (Costa, 1834)
*Nabis lativentris* Boheman, 1852
Montandon, 1886: Gorica; Gräffe, 1911: Tolmein (= Tolmin); Gogala & Moder, 1960: Ljubljana, Bohinj, Tržič, Brežice, Sečovlje; Gogala & Gogala, 1986, 1989, 1994; Gogala *et al.*, 1990; Protić, 1998
Specimens examined:
Ljubljana, Ježica, VM60, 25. 3. 1934, Staudacher leg.
Zveriče (= Zvirče), VM43, 24. 5. 1931, Staudacher leg.
Prekmurje: Žitkovci, XM06, 21. 5. 1970, Drovenik leg.
Medvode, VM51, 17. 3. 1979, A. & M. Gogala leg.
Ljubljana, Tacen, VM50, 2. 3. 1980, A. & M. Gogala leg.
Ljubljansko barje: Bevke, VL59, 29. 5. 1980, A. & M. Gogala leg.
Ljubljana, Šiška, VM50, 25. 6. 1980, A. & M. Gogala leg.
Ljubljansko barje: Vnanje Gorice, VL59, 27. 8. 1980, A. & M. Gogala leg.
Istra: Koštabona, VL03, 25. 6. 1981, M. Gogala leg.
Bela krajina: Zilje, WL23, 13. 9. 1981, A. & M. Gogala leg.
Vipavska dol.: Ajdovščina, VL18, 2. 8. 1985, A. & M. Gogala leg.
Istra: Strunjan, UL94, 16. 10. 1985, A. & M. Gogala leg.
Istra: Boršt, VL03, 3. 5. 1986, A. & M. Gogala leg.
Istra: Portorož, UL84, 15. 10. 1986, A. & M. Gogala leg.
Cerkniško jezero: Dolenje Jezero, VL56, 24. 5. 1987, A. & M. Gogala leg.
Prekmurje: Korovci, WM77, 14. 6. 1987, A. & M. Gogala leg.
Ljubljana, Savlje, VM60, 11. 4. 1988, A. & M. Gogala leg.
Šmarje pri Jelšah, WM42, 17. 8. 1988, A. & M. Gogala leg.
Sp. Brnik, VM62, 7. 9. 1988, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 2. 5. 1989, M. Gogala leg.
Istra: Izola, Šared, UL94, 11. 5. 1989, M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 3. 10. 1990, A. & M. Gogala leg.
Celje, Griže, WM12, 21. 3. 1992
Dobrova, Šujica, VM50, 7. 2. 1998, A. & M. Gogala leg.
Prekmurje: Sotina, WM78, 30. 7. 1998, S. Brelih leg.
Hrpelje, Prešnica, VL14, 10. 5. 1999, 7. 6. 1999, S. Brelih leg.
Ig, Matena, VL69, 24. 4. 1999, S. Brelih leg.
Sočerga, Šeki, VL13, 17. 6. 1999, S. Brelih leg.
Podsreda, Trebča Gorca, WM40, 18. 5. 2000, S. Brelih leg.
Bovec – Kanin, UM83, 11. 7. 2002, S. Brelih leg.
Nova Gorica, Panovec, 100 m, UL98, 10. 5. 2001, S. Brelih leg.
Lipica, VL15, 25. 5. 1985, V. Furlan leg.
Ljubljana, Golovec, VL69, 20. 5. 1984, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 10. 4. 1989, V. Furlan leg.
Divača, VL15, 25. 5. 1985, V. Furlan leg.
Bela krajina: Podzemelj, WL25, 28. 4. 1983, V. Furlan leg.
Novo mesto, Trška gora, WL17, 21. – 22. 5. 1983, V. Furlan leg.
Ljubljana, Šmartno, VM60, 4. 5. 1988, V. Furlan leg.
Mali Kum, 813 m, WM00, 6. 5. 1988, V. Furlan leg.
Ljubljana, Črnuče, Jarški prod, VM60, 27. 5. 1987, 22. 5. 1991, V. Furlan leg.
Iška vas, VL68, 3. 5. 1987, V. Furlan leg.
Radeče, Jagnjenica, WM00, 24. 5. 1990, V. Furlan leg.
Ljubljana, Lavrica, VL69, 29. 4. 1991, V. Furlan leg.

***Himacerus apterus*** (Fabricius, 1798)
Gogala & Moder, 1960: Carniola, Ljubljana, Lancovo, Brežice; Gogala & Gogala, 1986, 1989; Protić, 1998: Podčetrtek
Specimens examined:
Laibach (= Ljubljana), 2. 8. 1929, Staudacher leg.
Lancovo, VM33, 4. 8. 1929, Staudacher leg.
Gabrovka, VL99, 1. 11. 1978, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 11. 7. 1981, A. & M. Gogala leg.
Medvode, Jeprca, VM51, 22. 8. 1981, A. & M. Gogala leg.
Kamnik pod Krimom, Ponikve, VL58, 4. 10. 1981, A. & M. Gogala leg.
Domžale, Dob, VM71, 24. 7. 1982, A. & M. Gogala leg.
Prekmurje: Petanjci, WM86, 24. 7. 1983, A. & M. Gogala leg.
Postojna, Zagon, VL37, 21. 9. 1983, A. & M. Gogala leg.
Krka, VL88, 12. 8. 1984, A. & M. Gogala leg.
Radlje ob Dravi, WM16, 22. 8. 1984, A. & M. Gogala leg.
Bohinj: Ukanc, VM02, 16. 11. 1986, A. & M. Gogala leg.
Šmarje pri Jelšah, WM42, 17. 8. 1988, A. & M. Gogala leg.
Sp. Brnik, VM62, 2. 9. 1988, M. Gogala leg.
Bloke: Bloško jezero, VL67, 10. 9. 1988, A. & M. Gogala leg.
Radenci, Hrastje-Mota, WM86, 29. 7. 1998, 7. 8. 1998, S. Brelih leg.

***Nabis viridulus*** Spinola, 1837
*Nabis viridis* Brullé, 1839
Gräffe, 1911: Lippiza (= Lipica)

***Nabis flavomarginatus*** Scholtz, 1847
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Rateče, VM05, 14. 7. 1979, A. & M. Gogala leg.
Cerknica, Dolenje Jezero, VL56, 29. 6. 1983, A. & M. Gogala leg.
Pohorje: Areh, WM35, 24. 7. 1983, A. & M. Gogala leg.
Jezersko, VM64, 14. 8. 1983, A. & M. Gogala leg.
Bloke: Bloško jezero, VL67, 7. 8. 1983, 11. 7. 1987, 10. 9. 1988, A. & M. Gogala leg.
Rakitna, VL58, 31. 7. 1984, A. & M. Gogala leg.
Osilnica, Plešce, slov. stran reke, VL74, 27. 7. 1985, A. & M. Gogala leg.
Vel. Bloke, 2 km E, VL67, 24. 8. 1985, A. & M. Gogala leg.
Pohorje: Rogla, WM24, 24. 7. 1993, A. & M. Gogala leg.
Kum, WM00, 23. 7. 1997, A. Kapla leg.
Bloke: Godičevo, VL67, 2. 7. 2000, A. & M. Gogala leg.
Pokljuka: Vel. Blejsko barje, VM23, 5. 8. 2003, A. & M. Gogala leg.
Pokljuka: Barje Šijec, VM23, 5. 8. 2003, A. & M. Gogala leg.

***Nabis brevis*** Scholtz, 1847
Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 11. 10. 1931, Staudacher leg.
Medvode, Goričane, VM51, 15. 7. 1980, A. & M. Gogala leg.
Ljubljansko barje: Dragomer, VL59, 25. 7. 1980, A. & M. Gogala leg.
Janče, VM70, 7. 6. 1981, A. & M. Gogala leg.
Ljubljana, Savlje, VM60, 18. 10. 1981, 13. 3. 1983, A. & M. Gogala leg.
Prekmurje: Petišovci, XM15, 30. 4. 1983, A. & M. Gogala leg.
Radlje ob Dravi, WM16, 22. 8. 1984, A. & M. Gogala leg.
Ljubljansko barje: Ig, VL69, 4. 5. 1985, A. & M. Gogala leg.
Polhograjsko hrib.: Črni vrh, Pasja ravan, VM40, 4. 6. 1985, A. & M. Gogala leg.
Žužemberk, VL97, 5. 3. 1989, A. & M. Gogala leg.
Ljubljana, Beričevo, VM70, 9. 11. 1996, A. & M. Gogala leg.
Ljubljansko barje: Bevke, VL49, 11. 10. 1999, A. & M. Gogala leg.
Ljubljansko barje: Ig, Iška loka, VL69, 3. 4. 1997, S. Brelih leg.
Gor. Radgona, Črešnjevci, WM76, 24. 4. 1998, S. Brelih leg.
Prekmurje: Ledavsko jezero, WM88, 6. 8. 1998, S. Brelih leg.
Nova Gorica, Panovec, UL98, 21. 4. 2000, 6. 7. 2000, S. Brelih leg.
Podsreda, Trebča Gorca, WM40, 18. 5. 2000, S. Brelih leg.
Muljava, VL88, 13. 3. 1983, 5. 10. 1983, V. Furlan leg.
Bela krajina: Stranska vas, WL15, 28. 4. 1983, V. Furlan leg.
Gorjanci: Jugorje, WL16, 27. 4. 1983, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 4. 5. 1984, 20. 5. 1984, 10. 4. 1989, V. Furlan leg.
Loški potok: Retje, VL66, 7. 10. 1983, V. Furlan leg.
Bela krajina: Podzemelj, WL25, 28. 4. 1983, V. Furlan leg.
Bela krajina: Preloka, WL23, 27. 4. 1983, V. Furlan leg.
Topol, Osredek, VM50, 18. 5. 1985, V. Furlan leg.
Mali Kum, 813 m, WM00, 6. 5. 1988, V. Furlan leg.

***Nabis ferus*** (Linnaeus, 1758)
? Montandon, 1886: Gorica (probably confused with other species); Gogala & Moder, 1960 (confused with other species); Protić, 1998

Specimen examined:
Cerkniško jezero: Gorenje Jezero, VL56, 23. 8. 2002, A. Gogala leg.

***Nabis pseudoferus*** Remane, 1949
Gogala & Gogala, 1986, 1989; Gogala *et al.*, 1990; Protić, 1998
Specimens examined:
Limbarska gora, VM81, 10. 2. 1980, A. & M. Gogala leg.
Istra: Marezige, VL04, 7. 9. 1985, A. & M. Gogala leg.
Istra: Labor, VL03, 9. 9. 1987, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 9. 7. 1989, A. & M. Gogala leg.
Istra: Strunjan, UL94, 17. 9. 1989, A. & M. Gogala leg.
Istra: Padna, UL93, 1. 2. 1997, A. & M. Gogala leg.
Braniška dol.: Dolanci, VL17, 13. 2. 2000, A. & M. Gogala leg.
Muljava, VL88, 13. 3. 1983, V. Furlan leg.
Ljubljana, Golovec, Orle, VL69, 21. 4. 1985, V. Furlan leg.
Bela krajina: Vinica, WL13, 29. 4. 1983, V. Furlan leg.

***Nabis punctatus*** Costa, 1847
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Istra: Koper, Škocjanski zatok, VL04, 1. 7. 1979, A. & M. Gogala leg.
Ljubljansko barje: Dragomer, VL59, 25. 7. 1980, A. & M. Gogala leg.
Istra: Koštabona, VL03, 25. 6. 1981, M. Gogala leg.
Polhograjsko hrib.: Črni vrh, VM40, 15. 5. 1982, A. & M. Gogala leg.
Medvode, Sora, Draga, VM51, 22. 7. 1982, A. & M. Gogala leg.
Istra: Strunjan, UL94, 22. 9. 1982, A. & M. Gogala leg.
Prekmurje: Dobrovnik, XM06, 23. 7. 1983, A. & M. Gogala leg.
Istra: Padna, UL93, 4. 11. 1983, A. & M. Gogala leg.
Sp. Brnik, VM62, 7. 9. 1988, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 21. 7. 1990, A. & M. Gogala leg.
Rakov Škocjan, VL47, 17. 8. 2001, A. Gogala leg.
Muljava, VL88, 24. 8. 1982, V. Furlan leg.

***Nabis riegeri*** Kerzhner, 1996
Specimens examined:
Istra: Koper, Bertoki, Škocjanski zatok, VL04, 7. 7. 2000, A. Gogala leg.

***Nabis rugosus*** (Linnaeus, 1758)
Montandon, 1886: Gorica; Gräffe, 1911: Loitsch (= Logatec), Tolmein (= Tolmin); Gogala & Moder, 1960: Ljubljana, Kamn. Bistrica, Bled, Bohinj, Birčna vas, Krka (Gospodična), Rakek; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998: Podčetrtek
Specimens examined:
Laibach (= Ljubljana), 21. 9. 1928, Staudacher leg.
Lancovo, VM33, 4. 8. 1929, Staudacher leg.
Gottschee (= Kočevje), VL85, 6. 6. 1937, Staudacher leg.
Veldes (= Bled), VM33, 2. 8. 1931, Staudacher leg.
Ljubljana, Rožnik, VM50, 24. 2. 1954, M. Gogala leg.
Bohinj: Ukanc, VM02, 4. 6. 1978, A. & M. Gogala leg.
Borovnica, Pokojišče, VL48, 28. 6. 1978, A. & M. Gogala leg.
Vipavska dol.: Ozeljan, VL08, 7. 4. 1979, A. & M. Gogala leg.
Slavnik, VL14, 31. 5. 1981, A. & M. Gogala leg.
Medvode, Preska, VM51, 4. 7. 1981, A. & M. Gogala leg.
Velike Lipljene, VL78, 30. 8. 1981, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 23. 6. 1982, M. Gogala leg.
Vrhnika, VL49, 11. 7. 1982, A. & M. Gogala leg.
Grosuplje, Polica, VL79, 24. 8. 1982, A. & M. Gogala leg.
Polhograjsko hrib.: Topol, sv. Katarina, VM50, 21. 4. 1983, M. Gogala leg.
Prekmurje: Dobrovnik, Bukovniško jezero, XM07, 30. 4. 1983, A. & M. Gogala leg.
Prekmurje: Petanjci, WM86, 24. 7. 1983, A. & M. Gogala leg.
Polhograjsko hrib.: Črni vrh, VM40, 4. 8. 1983, A. & M. Gogala leg.
Postojna, Zagon, VL37, 21. 9. 1983, A. & M. Gogala leg.
Istra: Boršt, VL03, 3. 5. 1986, A. & M. Gogala leg.
Rakitna, VL58, 22. 6. 1986, A. & M. Gogala leg.
Pomurje: Veržej, WM86, 13. 6. 1987, A. & M. Gogala leg.
Prekmurje: Korovci, WM77, 14. 6. 1987, A. & M. Gogala leg.
Bloke: Bloško jezero, VL67, 11. 7. 1987, A. & M. Gogala leg.
Istra: Labor, VL03, 9. 9. 1987, A. & M. Gogala leg.
Trnovski gozd, Čaven, VL08, 11. 6. 1988, A. & M. Gogala leg.
Idrija, Krekovše, VL19, 28. 6. 1988, M. Gogala leg.
Šmarje pri Jelšah, WM42, 17. 8. 1988, A. & M. Gogala leg.
Zg. Radovna, VM14, 28. 8. 1988, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 2. 5. 1989, M. Gogala leg.
Istra: Izvir Rižane, VL14, 18. 2. 1990, A. & M. Gogala leg.
Kras: Trstelj, UL98, 19. 8. 1990, 1. 7. 2001, A. & M. Gogala leg.
Kum, Dobovec, WM00, 28. 5. 1991, V. Furlan leg.
Kum, Podkraj, WM00, 30. 5. 1991, V. Furlan leg.
Mrzlica, 1100 m, WM01, 28. 5. 1991, V. Furlan leg.
Golovec: Orle, VL69, 13. 3. 1991, V. Furlan leg.
Zalog, Laze pri Dolskem, VM70, 29. 5. 1991, V. Furlan leg.

Breginj, Logje, UM72, 12. 6. 1997, S. Brelih leg.
Podsreda, Loke, WM40, 9. 7. 1998, S. Brelih leg.
Ig, Kremenica, VL68, 23. 5. 1998, S. Brelih leg.
Prekmurje: Ledavsko jezero, WM88, 6. 8. 1998, S. Brelih leg.
Hrpelje, Prešnica, VL14, 6. 7. 1998, S. Brelih leg.
Radenci, Hrastje-Mota, WM86, 7. 8. 1998, S. Brelih leg.
Čaven: pl. koča, VL18, 27. 5. 1999, S. Brelih leg.
Jul. Alpe: Možnica, 640 m, UM93, 9. 7. 2002, S. Brelih leg.
Muljava, VL88, 27. 5. 1982, V. Furlan leg.
Gornji Ig, 600 m, VL68, 5. 6. 1982, V. Furlan leg.
Kras: Lipica, VL15, 30. 5. 1982, V. Furlan leg.
Ljubljana, Golovec, VL69, 4. 6. 1982, V. Furlan leg.
Kurešček, VL68, 5. 6. 1983, V. Furlan leg.
Gorjanci: sedlo, 635 m, WL16, 27. 4. 1983, V. Furlan leg.
Bela krajina: Žuniči, WL23, 27. 4. 1983, V. Furlan leg.
Bela krajina: Preloka, WL23, 27. 4. 1983, V. Furlan leg.
Bela krajina: Gradac, WL15, 28. 4. 1983, V. Furlan leg.
Bela krajina: Podzemelj, WL25, 28. 4. 1983, V. Furlan leg.
Novo mesto, Trška gora, WL17, 21. – 22. 5. 1983, V. Furlan leg.
Suha krajina: Žvirče, VL87, 7. 5. 1983, V. Furlan leg.
Krma, VM14, 14. 5. 1983, V. Furlan leg.
Radovna, VM24, 14. 5. 1983, V. Furlan leg.
Polhov Gradec, VM40, 6. 5. 1984, V. Furlan leg.
Povir, Brestovica, VL16, 16. 5. 1984, V. Furlan leg.
Ratitovec: Prtovč, VM22, 10. 6. 1984, V. Furlan leg.
Divača, VL15, 25. 5. 1985, V. Furlan leg.
Podkum, Medvedov graben, WM00, 10. 5. 1989, V. Furlan leg.
Kum, Dobovec, WM00, 28. 5. 1991, V. Furlan leg.
Mrzlica, 1100 m, WM01, 28. 5. 1991, V. Furlan leg.

**Anthocoridae**

***Acompocoris alpinus*** Reuter, 1875
Gogala & Gogala, 1989; Protić, 1998; Floren & Gogala, 2002
Specimens examined:
Polhograjsko hrib.: Črni vrh, Pasja ravan, VM40, 15. 8. 1984, A. & M. Gogala leg.
Pohorje: Lovrenc, Jezerska jama (Ribnik), WM24, 23. 8. 1987, A. & M. Gogala leg.
Karavanke: Košuta: Pl. Šija, 1530 – 1800 m, VM44, 20. 8. 1991, A. & M. Gogala leg.
Kočevski Rog, Baza 20, 900 m, WL06, 26. 6. 1999, A. Floren leg.
Ig, Škrilje, Stražar, VL68, 30. 5. 2000, A. & M. Gogala leg.
Karavanke: pl. Pungrat, 1440 m, VM54, 20. 6. 2000, S. Brelih leg.

***Acompocoris montanus*** Wagner, 1955
Gogala & Gogala, 1989; Gogala, 1992; Protić, 1998
Specimens examined:
Pohorje: Lovrenška jezera, WM24, 23. 8. 1987, A. & M. Gogala leg.

***Anthocoris amplicollis*** Horváth, 1893
Gogala & Gogala, 1989; Protić, 1998
Specimens examined:
Bohinj: Ukanc, VM02, 4. 8. 1984, A. & M. Gogala leg.
Planinsko polje: Grčarevec, VL48, 22. 7. 1987, A. & M. Gogala leg.

***Anthocoris confusus*** Reuter, 1884
Gogala & Gogala, 1986, 1989; Protić, 1998; Floren & Gogala, 2002
Specimens examined:
Prekmurje: Selo, WM97, 5. 7. 1980, A. & M. Gogala leg.
Janče, VM70, 7. 6. 1981, A. & M. Gogala leg.
Planinsko polje: Planina, VL47, 19. 4. 1981, A. & M. Gogala leg.
Krvavec, VM62, 14. 6. 1981, A. & M. Gogala leg.
Slavnik, VL14, 2. 7. 1982, A. & M. Gogala leg.
Medvode, Babni dol, VM50, 22. 6. 1983, A. & M. Gogala leg.
Polhograjsko hrib.: Črni vrh, VM40, 10. 8. 1983, A. & M. Gogala leg.
Ljubljansko barje: Vrhnika, Log, 15. 7. 1984, VL59, A. & M. Gogala leg.
Kamniško-Savinjske Alpe: Okrešelj, VM63, 25. 6. 1988, A. & M. Gogala leg.
Karavanke: Solčava, Žibovt – Kisla voda, VM74, 26. 6. 1988, A. & M. Gogala leg.
Podčetrtek, Pristava, WM41, 11. 4. 1990, A. & M. Gogala leg.
Kum, WM00, 8. 5. 1998, A. & M. Gogala leg.
Kočevski Rog, Baza 20, 900 m, WL06, 25. 6. 1999, A. Floren leg.
Dobrova, VM50, 20. 4. 1979, V. Furlan leg.

***Anthocoris gallarumulmi*** (De Geer, 1773)
Montandon, 1886: Gorica; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Ljubljansko barje: Log, Lukovica, VL59, 4. 7. 1979, A. Gogala leg.
Bohinjska Bistrica, Nemški rovt, VM22, 25. 7. 1979, A. & M. Gogala leg.
Jezersko, VM64, 14. 8. 1983, A. & M. Gogala leg.
Istra: Dragonja, Stena, UL93, 1. 2. 1997, A. & M. Gogala leg.
Dragonja, UL93, 4. 5. 2000, S. Brelih leg.

***Anthocoris limbatus*** Fieber, 1836
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Cerknica, Begunje, Topol, VL57, 28. 6. 1981, A. & M. Gogala leg.
Planina, Planinsko polje, VL47, 4. 6. 2000, A. Gogala leg.
Ljubljana, Barje, VL69, 4. 4. 1982, 11. 4. 1982, V. Furlan leg.

***Anthocoris nemoralis*** (Fabricius, 1794)
Gogala & Gogala, 1986, 1989; Protić, 1998; Floren & Gogala, 2002
Specimens examined:
Istra: Koper, Škocjanski zatok, VL04, 18. 5. 1980, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 20. 3. 1983, A. & M. Gogala leg.
Laško, Šmohor, WM11, 13. 7. 1984, A. & M. Gogala leg.
Brežice, Čatež, WL48, 6. 5. 1986, M. Gogala leg.
Cerkniško jez.: Dol. Jezero, VL56, 24. 5. 1987, A. & M. Gogala leg.
Krško, Anovec, WL49, 1. 8. 1996, A. & M. Gogala leg.
Kočevski Rog, Baza 20, 900 m, WL06, 28. 6. 1999, A. Floren leg.
Muljava, VL88, 4. 4. 1982, 26. 4. 1982, V. Furlan leg.
Ljubljana, Golovec, VL69, 4. 4. 1982, V. Furlan leg.
Kurešček, 800 m, VL68, 14. 4. 1979, V. Furlan leg.

***Anthocoris nemorum*** (Linnaeus, 1761)
Gogala & Moder, 1960: Stol (Žirovniška pl.), 7 jezer, Mojstrana, Bohinj, Lubnik; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Bohinj: Ukanc, VM02, 3. 7. 1977, 4. 6. 1978, A. & M. Gogala leg.
Ljubljansko barje: Plešivica, VL59, 23. 4. 1978, A. & M. Gogala leg.
Ljubljana, Sostro, VL79, 21. 4. 1979, A. & M. Gogala leg.
Brezje, VM43, 24. 4. 1979, A. & M. Gogala leg.
Ljubelj, VM44, 14. 7. 1979, A. & M. Gogala leg.
Velike Lašče, VL77, 25. 5. 1980, A. & M. Gogala leg.
Slavnik, VL14, 31. 5. 1981, A. & M. Gogala leg.
Krvavec, VM62, 14. 6. 1981, A. & M. Gogala leg.
Bohinjska Bistrica, Nemški rovt, VM22, 25. 7. 1979, A. & M. Gogala leg.
Cerknica, Begunje, Topol, VL57, 28. 6. 1981, A. & M. Gogala leg.
Velike Lipljene, VL78, 30. 8. 1981, A. & M. Gogala leg.
Borovnica, Pokojišče, VL48, 7. 9. 1981, A. & M. Gogala leg.
Ljubljansko barje: Matena, Iška loka, VL69, 11. 4. 1982, A. & M. Gogala leg.
Soška dol.: izliv Lepenjice, UM93, 18. 7. 1982, A. & M. Gogala leg.
Medvode, Sora, Draga, VM51, 22. 7. 1982, A. & M. Gogala leg.
Julijske Alpe: Komna, VM02, 7. 7. 1983, A. & M. Gogala leg.
Rovte, VL39, 22. 7. 1983, A. & M. Gogala leg.
Pohorje: Areh, WM35, 24. 7. 1983, A. & M. Gogala leg.
Jezersko, VM64, 14. 8. 1983, A. & M. Gogala leg.
Laško, Šmohor, WM11, 13. 7. 1984, A. & M. Gogala leg.
Vuhred, Hudi kot, WM15, 2. 6. 1986, M. Gogala leg.
Vel. Bloke, VL67, 19. 4. 1987, A. & M. Gogala leg.
Cerkniško jez.: Dol. Jezero, VL56, 24. 5. 1987, A. & M. Gogala leg.
Paninsko polje: Grčarevec, VL48, 22. 7. 1987, A. & M. Gogala leg.
Pohorje: Lovrenc, Jezerska jama (Ribnik), WM24, 23. 8. 1987, A. & M. Gogala leg.
Osilnica, Plešce, slov. str. reke, VL74, 27. 7. 1985, A. & M. Gogala leg.
Borovnica, Pekel, VL58, 27. 4. 1988, A. & M. Gogala leg.
Čaven, VL08, 11. 6. 1988, A. & M. Gogala leg.
Kamniško-Savinjske Alpe: Okrešelj, VM63, 25. 6. 1988, A. & M. Gogala leg.
Karavanke: Solčava, Žibovt – Kisla voda, VM74, 26. 6. 1988, A. & M. Gogala leg.
Bloke: Bloško jezero, VL67, 10. 9. 1988, A. & M. Gogala leg.
Snežnik, VL54, 22. 7. 1992, A. & M. Gogala leg.
Kum, WM00, 8. 5. 1998, A. & M. Gogala leg., 1216 m, 4. 6. 1988, 1000 m, 7. 5. 1989, V. Furlan leg.
Trnje, Sv. Trojica, 1100 m, VL46, 8. 6. 2002, A. Gogala leg.
Begunjščica, 1300 m, VM34, 10. 8. 1991, V. Furlan leg.
Mrzlica, Preval Vrhe, WM01, 28. 5. 1991, V. Furlan leg.
Mrzlica, 1100 m, WM01, 28. 5. 1991, V. Furlan leg.
Soriška pl., 1300 m, VM22, 11. 7. 1991, V. Furlan leg.
Menina pl., VM82, 20. 6. 1991, V. Furlan leg.
Topol, Sv. Katarina, VM50, 9. 6. 1991, V. Furlan leg.
Ljubljana, Polje, Slape, VM60, 23. 5. 1991, V. Furlan leg.
Ljubljana, Barje, VL69, 4. 4. 1982, 11. 4. 1982, 18. 4. 1982, 29. 3. 1989, V. Furlan leg.
Pohorje: Ribniški vrh, 1500 m, WM25, 20. 7. 1989, V. Furlan leg.
Iška vas, VL68, 3. 5. 1987, V. Furlan leg.
Ljubljana, 9. 2. 1997, S. Gomboc leg.
Ribnica na Pohorju, WM25, 17. 5. 1997, D. Kofol leg.
Krim, 700 m, VL58, 31. 3. 1997, S. Brelih leg.
Ig, Škrilje, VL68, 8. 6. 1997, S. Brelih leg.
Kočevje, Dolga vas, 480 m, VL95, 4. 7. 1997, S. Brelih leg.
Čaven: pl. koča, 1240 m, VL18, 27. 5. 1999, S. Brelih leg.
Bavšica, UM93, 22. 7. 2000, S. Brelih leg.

Kamn. Alpe: Dol. Korošice, VM62, 23. 5. 2001, S. Brelih leg.
Kurešček, 800 m, VL68, 14. 4. 1979, V. Furlan leg.
Col, Črni vrh, VL28, 21. 4. 1979, V. Furlan leg.
Idrija, Hleviška pl., 800 m, VL29, 15. 4. 1979, V. Furlan leg.
Lubnik, 1025 m, VM41, 4. 4. 1981, V. Furlan leg.
Ljubljana, Golovec, VL69, 4. 4. 1982, V. Furlan leg.
Mokrec, 900 m, VL68, 11. 4. 1982, 9. 8. 1982, V. Furlan leg.
Vremščica, VL26, 25. 4. 1982, V. Furlan leg.
Polhov Gradec, Mačkov graben, VM40, 27. 4. 1982, V. Furlan leg.
Polhov Gradec, VM40, 17. 4. 1983, V. Furlan leg.
Kamniška Bistrica, Korošica, VM63, 24. 4. 1982, V. Furlan leg.
Karavanke: Dom pod Storžičem, 1100 m, VM53, 22. 5. 1982, V. Furlan leg.
Muljava, VL88, 26. 4. 1982, V. Furlan leg.
Ratitovec, 1100 m, VM22, 6. 6. 1982, V. Furlan leg.
Škofja Loka, Praprotno, VM41, 24. 4. 1983, V. Furlan leg.
Gorjanci: sedlo, 635 m, WL16, 27. 4. 1983, V. Furlan leg.
Radovna, VM24, 14. 5. 1983, V. Furlan leg.
Krma, VM14, 14. 5. 1983, V. Furlan leg.
Krim, 700 m, VL58, 30. 7. 1983, V. Furlan leg.
Ratitovec: Prtovč, VM22, 10. 6. 1984, V. Furlan leg.
Kamniško sedlo, 1900 m, VM63, 10. 8. 1985, V. Furlan leg.
Ljubljana, Zadvor, VL69, 30. 4. 1985, V. Furlan leg.
Podkum, Sopota, WM00, 26. 3. 1988, 24. 5. 1990, V. Furlan leg.
Zasavje: Mali Kum, 813 m, WM00, 6. 5. 1988, 6. 7. 1988, V. Furlan leg.
Borovak pri Podkumu, WM00, 30. 4. 1990, 9. 5. 1990, V. Furlan leg.

***Elatophilus nigricornis*** (Zetterstedt, 1838)
Gogala & Gogala, 1989; Protić, 1998
Specimens examined:
Trnovski gozd: Čaven, Kucelj, VL08, 11. 6. 1988, A. & M. Gogala leg.

***Elatophilus stigmatellus*** (Zetterstedt, 1838)
Gogala & Gogala, 1989; Protić, 1998
Specimens examined:
Bloke: Bloško jezero, VL67, 11. 7. 1987, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 25. 2. 1990, A. & M. Gogala leg.

***Temnostethus reduvinus*** (Herrich-Schaeffer, 1850)
Reuter, 1888: Gorica

***Temnostethus gracilis*** Horváth, 1907
Gogala & Gogala, 1986, 1989; Protić, 1998; Floren & Gogala, 2002
Specimens examined:
Ljubljansko barje: Log, Lukovica, VL59, 26. 8. 1984, 7. 7. 1985, 29. 6. 2001 on *Malus*, A. & M. Gogala leg.
Osilnica, Plešce, slov. str. reke, VL74, 27. 7. 1985, A. & M. Gogala leg.
Kočevski Rog, Baza 20, 900 m, WL06, 25. 6. 1999, 28. 6. 1999, A. Floren leg.

***Temnostethus longirostris*** (Horváth, 1907)
Gogala & Gogala, 1989; Protić, 1998
Specimen examined:
Pomurje: Veržej, WM86, 13. 6. 1987, A. & M. Gogala leg.

***Temnostethus pusillus*** (Herrich-Schaeffer, 1835)
Gogala & Gogala, 1986, 1989; Protić, 1998; Floren & Gogala, 2002
Specimens examined:
Ljubljansko barje: Log, Lukovica, VL59, 11. 9. 1983, 26. 8. 1984, A. & M. Gogala leg.
Bloke: Rogovila, VL67, 11. 7. 1987, A. & M. Gogala leg.
Kočevski Rog, Baza 20, 900 m, WL06, 25. 6. 1999, A. Floren leg.

***Temnostethus wichmanni*** Wagner, 1961
Floren & Gogala, 2002
Specimens examined:
Kočevski Rog, Baza 20, 900 m, WL06, 28. 6. 1999, A. Floren leg.

***Tetraphleps bicuspis*** (Herrich-Schaeffer, 1835)
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Bohinjska Bistrica, Nemški rovt, VM22, 25. 7. 1979, 15. 8. 1981, A. & M. Gogala leg.
Ljubljana, Šiška, VM50, 25. 6. 1980 on *Larix*, A. Gogala leg.
Grosuplje, Polica, VL79, 27. 9. 1980, A. & M. Gogala leg.
Kamniško-Savinjske Alpe: Velika planina, VM72, 15. 10. 1978, A. & M. Gogala leg.
Horjul, Lesno brdo, VL49, 8. 6. 1986, A. & M. Gogala leg.

***Orius horvathi*** (Reuter, 1884)
Floren & Gogala, 2002
Specimens examined:
Kočevski Rog, Baza 20, 900 m, WL06, 25. 6. 1999, A. Floren leg.

***Orius laticollis*** (Reuter, 1884)
Gogala & Gogala, 1986, 1989; Protić, 1998; Floren & Gogala, 2002

Specimens examined:
Bohinj: Ukanc, VM02, 31. 7. 1983, A. Gogala leg.
Kočevski Rog, Baza 20, 900 m, WL06, 26. 6. 1999, A. Floren leg.
Vrhnika, VL49, 22. 1. 2004 on *Platanus*, A. Gogala leg.

***Orius majusculus*** (Reuter, 1879)
Montandon, 1886: Gorica; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Prekmurje: Selo, WM97, 5. 7. 1980, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 4. 10. 1996, A. & M. Gogala leg., 7. 7. 2004, A. Gogala leg.
Rakov Škocjan, VL47, 17. 8. 2001, A. Gogala leg.
Ljubljana, Golovec, Orle, VL69, 21. 4. 1985, 10. 4. 1989, V. Furlan leg.
Ljubljana, Polje, Slape, VM60, 23. 5. 1991, V. Furlan leg.
Ljubljana, Lavrica, VL69, 25. 4. 1991, 29. 4. 1991, V. Furlan leg.
Ljubljana, Šmartno, VM60, 4. 5. 1988, V. Furlan leg.
Ljubljana, Barje, VL69, 26. 2. 1992, V. Furlan leg.
Ljubljana, Zalog, Laze, VM70, 29. 5. 1991, V. Furlan leg.
Iška vas, VL68, 3. 5. 1987, V. Furlan leg.
Brežice, Terme Čatež, WL48, 25. 4. 1998, V. Furlan leg.
Zasavje: Renke, VM90, 13. 9. 1991, V. Furlan leg.
Cerkniško jezero: Goričica, VL56, 10. 4. 1991, V. Furlan leg.

***Orius minutus*** (Linnaeus, 1758)
Gogala & Moder, 1960: Ljubljana, Bohinj, Celje, Brežice; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Ljubljansko barje: Log, Lukovica, VL59, 9. 1981, A. & M. Gogala leg.
Ljubljana: Ilovica, VL69, 10. 9. 1983, A. & M. Gogala leg.
Ljubljana, VM60, 22. 11. 1982, 23. 9. 1990, V. Furlan leg.
Ljubljana, Barje, VL69, 24. 2. 1992, V. Furlan leg.
Rakov Škocjan, VL47, 17. 8. 2001, A. Gogala leg.

***Orius niger*** (Wolff, 1811)
Gräffe, 1911: Tolmein (= Tolmin); Gogala & Moder, 1960: Črni Kal; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Koper, Škocjanski zatok, VL04, 1. 7. 1979, A. & M. Gogala leg.
Istra: Portorož, Lucija, UL94, 2. 7. 1983, A. & M. Gogala leg.
Istra: Portorož, UL94, 1. 10. 1987, A. & M. Gogala leg.
Istra: Pomjan, VL03, 9. 6. 1990, A. & M. Gogala leg.
Istra: Popetre, 300 m, VL13, 9. 7. 1997, S. Brelih leg.
Istra: Boršt, Kozloviči, 260 m, VL03, 9. 7. 1997, S. Brelih leg.
Komen, Branik, VL07, 27. 5. 1998, S. Brelih leg.
Bovec – Kanin, UM83, 23. 7. 2000, S. Brelih leg.
Brkini: Rodik, 500 m, 7. 6. 2001, S. Brelih leg.
Zasavje: Podkraj, WM00, 14. 6. 1990, V. Furlan leg.
Ljubljana, Lavrica, VL69, 23. 4. 1991, V. Furlan leg.
Mozirje, Šmihel, VM93, 15. 8. 1998, V. Furlan leg.

***Brachysteles parvicornis*** (Costa, 1847)
Specimen examined:
Istra: Sečovlje, Fontanigge, UL93, 17. 9. 2002, A. Gogala leg.

***Cardiastethus nazarenus*** Reuter, 1884
Specimen examined:
Istra: Dragonja, Stena, UL93, 1. 2. 1997, A. & M. Gogala leg.

***Dufouriellus ater*** (Dufour, 1833)
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Ljubljansko barje: Ig, Dobravica, Kremenica, VL68, 3. 2. 1980, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 1. 11. 1983, A. & M. Gogala leg.
Podčetrtek, Pristava, WM41, 11. 4. 1990, A. & M. Gogala leg.
Istra: Sečovlje, Sv. Onofrij, UL93, 28. 2. 1992, A. & M. Gogala leg.

***Dysepicritus rufescens*** (Costa, 1847)
Reuter, 1888: Gorica

***Xylocoridea brevipennis*** Reuter, 1876
Gogala, 1996; Protić, 1998
Specimens examined:
Kras: Gorjansko, UL97, 22. 2. 1992, M. Gogala leg.
Vrhnika, VL49, 22. 1. 2004 on *Platanus*, A. Gogala leg.

***Lyctocoris campestris*** (Fabricius, 1794)
Montandon, 1886: Gorica; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Ljubljansko barje: Ig, Kremenica, VL68, 6. 9. 1975, S. Brelih leg.
Prekmurje: Moravci, WM97, 30. 4. 1983, A. & M. Gogala leg.
Polhograjsko hrib.: Črni vrh, VM40, 10. 8. 1983, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 17. 5. 1988, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 15. 8. 1990, 3. 5. 2002, A. & M. Gogala leg.
Hrastnik, WM01, 9. 1997, A. Kapla leg.
Polhov Gradec, VM40, 17. 4. 1983, V. Furlan leg.

Zasavje: Kum, 1216 m, WM00, 4. 6. 1988, V. Furlan leg.
Ljubljana, 17. 8. 1984, V. Furlan leg.

***Lyctocoris dimidiatus*** (Spinola, 1837)
Gogala, 1996; Protić, 1998
Specimen examined:
Kranj, Sr. Bitnje, VM41, 17. 4. 1992, *Delichon* nest, T. Trilar leg.

***Xylocoris cursitans*** (Fallén, 1807)
Gogala & Gogala, 1986, 1989; Protić, 1998: Podčetrtek
Specimens examined:
Kras: Senožeče, Dolenja vas, VL26, 24. 3. 1959
Kras: Senožeče, VL26, 15. 4. 1979, A. & M. Gogala leg.
Ljubljansko barje: Ig, Draga, VL68, 8. 8. 1976, S. Brelih leg.
Polhograjsko hrib.: Črni vrh, VM40, 15. 5. 1982, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 11. 3. 1984, A. & M. Gogala leg.
Brkini: Barka, VL25, 28. 7. 1984, A. & M. Gogala leg.
Brkini: Artviže, VL25, 28. 7. 1984, A. & M. Gogala leg.
Šmarje pri Jelšah, WM42, 17. 8. 1988, A. & M. Gogala leg.
Nova Gorica, Panovec, UL98, 13. 9. 2000, 16. 3. 2001, S. Brelih leg.
Kostel, Stružnica, VL83, 28. 4. 2004, S. Brelih leg.

**Cimicidae**

***Cimex lectularius*** Linnaeus, 1758
Gogala & Moder, 1960: Ljubljana, Log v Trenti, Goriška brda; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 30. 8. 1929, Staudacher leg.
Ljubljana: Center, VM60, 13. 1. 1981, M. Gogala leg.
Ljubljana: Brodarjev trg, VM60, 10. 5. 2004, B. Čuden leg.

***Oeciacus hirundinis*** (Lamarck, 1816)
Gogala & Gogala, 1986, 1989; Trilar *et al.*, 1997: Maribor, Snežnik (Sviščaki), Bled, Kranj (Planina, Savska loka), Ljubljana (Šiška); Protić, 1998
Specimens examined:
Kranj, Planina, VM52, 26. 3. 1993, *Delichon urbica* nest, T. Trilar leg.

**Reduviidae**

***Gardena insignis*** Horváth, 1887 (Fig. 2)
Horváth, 1887: Gorica: **holotype**; Gogala *et al.*, 1990; Gogala, 1991, 1992; Protić, 1998
Specimen examined:
Istra: Dragonja, Stena, UL93, 17. 9. 1989, A. & M. Gogala leg.

***Fig. 2:*** *Gardena insignis* ***was described after a specimen found in Gorica, which is today situated along the Slovene-Italian border. A century later we discovered another specimen near the village of Dragonja in Slovene Istria.***
***Sl. 2: Vrsta*** *Gardena insignis* ***je bila opisana po primerku, najdenem v Gorici, ki danes leži ob slovensko-italijanski meji. Stoletje pozneje smo drugi primerek našli pri Dragonji v Slovenski Istri.***

***Ploiaria domestica*** Scopoli, 1786
Montandon, 1886: Gorica; Gogala & Moder, 1960: Ljubljana; Protić, 1998

***Metapterus caspicus*** (Dohrn, 1863)
Gogala & Gogala, 1989 (as *M. linearis*), 1994; Gogala *et al.*, 1990; Gogala, 1991; Protić, 1998
Specimens examined:
Istra: Črni kal, VL14, 1. 11. 1986, A. & M. Gogala leg.
Istra: Dragonja, Stena, UL93, 17. 9. 1989, 6. 5. 2000, A. & M. Gogala leg.

***Metapterus linearis*** Costa, 1862
? Montandon, 1886: Gorica (probably confused with *M. caspicus*). Other records refer to *M. caspicus*.

***Empicoris baerensprungi*** (Dohrn, 1863)
Gogala & Gogala, 1986, 1989; Protić, 1998; Floren & Gogala, 2002
Specimens examined:
Kočevski Rog, Baza 20, 900 m, WL06, 26. 6. 1999, A. Floren leg.
Istra: Portorož, Lucija, UL94, 2. 7. 1983, A. & M. Gogala leg.

***Empicoris culiciformis*** (De Geer, 1773)
Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Ljubljansko barje: Log, Lukovica, VL59, 16. 5. 1982, 27. 6. 1982, 10. 10. 1982, 26. 5. 1983, 24. 7. 1988, A. & M. Gogala leg.

Ljubljana: Center, VM60, 23. 6. 1986, M. Gogala leg.
Kras: Brje pri Komnu, VL07, 31. 8. 1991, A. & M. Gogala leg.

***Empicoris vagabundus*** (Linnaeus, 1758)
Gogala & Gogala, 1986, 1989; Protić, 1998; Floren & Gogala, 2002
Specimens examined:
Kočevski Rog, Baza 20, 900 m, WL06, 28. 6. 1999, A. Floren leg.
Istra: Portorož, Lucija, UL94, 2. 7. 1983, A. & M. Gogala leg.

***Ectomocoris chiragra*** (Fabricius, 1803)
Gräffe, 1911: Görz (= Gorica)

***Peirates hybridus*** (Scopoli, 1763)
Scopoli, 1763: In Carnioliae collibus (= Carniolan hills): **syntype(s)**; Montandon, 1886: Gorica; Gräffe, 1911: Görz (= Gorica); Gogala & Moder, 1960: Ljubljana, Notranjsko, Sečovlje; Gogala & Gogala, 1986, 1989; Protić, 1998: Podčetrtek
Specimens examined:
Ljubljana, Vižmarje, VM50, 25.10.1929, Staudacher leg.
Laibach (= Ljubljana), 5. 4. 1930, 20. 9. 1942, Staudacher leg.
Ljubljana, Tacen, VM50, 22. 10. 1976, A. & M. Gogala leg.
Medvode, Pirniče, VM51, 13. 2. 1977, A. & M. Gogala leg.
Istra: Koper, Škocjanski zatok, VL04, 18. 5. 1980, A. & M. Gogala leg.
Ljubljana, Savlje, VM60, 15. 4. 1987, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 28. 5. 1989, A. & M. Gogala leg.
Braniška dol.: Sp. Branica, Čipnje, VL07, 23. 5. 1993, A. & M. Gogala leg.
Istra: Portorož, Lucan, UL94, 27. 4. 1999, A. Kapla leg.
Prekmurje: Bukovnica, XM07, 23. 2. 1997, S. Gomboc leg.
Ljutomer, Podgradje, ribnik, WM95, 27. 5. 1997, S. Brelih leg.
Prekmurje: Bukovniško jezero, XM07, 27. 6. 1997, D. Kofol & S. Gomboc leg.
Ljubljana, Golovec, Orle, VL69, 15. 4. 1984, V. Furlan leg.
Šempeter pri Novi Gorici, UL98, 3. 5. 1990, S. Brelih leg.

***Phymata crassipes*** (Fabricius, 1775)
Montandon, 1886: Gorica; Gogala & Moder, 1960: Carniola, Ljubljana, Bohinj, Zagorje, Kum, Pokojišče, Črni Kal; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Specimens examined:
Ljubljana, Črnuče, VM60, 25. 6. 1933, Staudacher leg.
Ljubljana, Črnuče, Jarški prod, VM60, 27. 5. 1987, 22. 5. 1991, V. Furlan leg., 23. 6. 2004, A. Gogala leg.
Zagorje ob Savi, WM00, 12. 6. 1932, Staudacher leg.
Borovnica, Pokojišče, VL48, 26. 6. 1932, Staudacher leg., 12. 9. 1982, A. & M. Gogala leg.
Laibach (= Ljubljana), 2. 6. 1937, Staudacher leg.
Kum, WM00, 14. 7. 1927, Staudacher leg.
Ljubljana, Utik, VM50, 8. 6. 1931, Staudacher leg.
Ljubljana, Ježica, VM60, 25. 5. 1930, Staudacher leg.
Istra: Črni kal, VL14, 30. 6. 1979, A. & M. Gogala leg.
Ljubljansko barje: Ig, Kremenica, VL68, 30. 5. 1976, S. Brelih leg.
Kras: Štorje, VL16, 22. 7. 1980, A. & M. Gogala leg.
Slavnik, VL14, 31. 5. 1981, A. & M. Gogala leg., 27. 4. 1977, 9. 6. 1979, 23. 6. 1991, V. Furlan leg.
Istra: Koštabona, VL03, 25. 6. 1981, M. Gogala leg., 7. 6. 1987, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 11. 7. 1981, A. & M. Gogala leg.
Bela krajina: Zilje, WL23, 13. 9. 1981, A. & M. Gogala leg.
Prekmurje: Dobrovnik, Bukovniško jezero, XM07, 30. 4. 1983, A. & M. Gogala leg.
Polhograjsko hrib.: Črni vrh, Pasja ravan, VM40, 15. 8. 1984, A. & M. Gogala leg.
Rakitna, VL58, 22. 6. 1986, A. & M. Gogala leg.
Ljubljana, Savlje, VM60, 15. 4. 1987, A. & M. Gogala leg.
Cerkniško jezero: Laze, VL56, 24. 5. 1987, A. & M. Gogala leg.
Prekmurje: Gomilica, XM06, 13. 6. 1987, A. & M. Gogala leg.
Prekmurje: Goričko: Trdkova, WM89, 14. 6. 1987, A. & M. Gogala leg.
Čaven, VL08, 11. 6. 1988, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 28. 5. 1989, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 18. 5. 1990, A. & M. Gogala leg., 16. 5. 1990, V. Furlan leg.
Ilirska Bistrica, Štanga, VL44, 22. 7. 1992, A. & M. Gogala leg.
Ig, Škrilje, Stražar, 720 m, VL68, 28. 5. 1999, A. & M. Gogala leg.
Julijske Alpe: Trenta, VM03, 13. 7. 2001, A. & M. Gogala leg.
Ljubljansko barje: Ig, Kremenica, VL68, 20. 7. 1997, 25. 8. 1997, S. Brelih leg.
Hrpelje, Prešnica, VL14, 6. 7. 1998, 13. 7. 1998, S. Brelih leg.
Nanos, Lanišče, 900 m, VL27, 2. 7. 1998 (larva), D. Kofol & S. Gomboc leg.
Petrinje, VL14, 27. 5. 2000, S. Gomboc & D. Kofol leg.
Kovk, 900 m, VL18, 4. 7. 1999, S. Gomboc & D. Kofol leg.
Nanos, VL27, 18. 5. 1975, V. Furlan leg., 500-600 m,

23. 5. 1998, S. Gomboc & D. Kofol leg.
Kras: Senadolice, VL16, 22. 5. 1979, M. Zdešar leg.
Polhograjsko hrib.: Grmada, VM40, 15. 6. 1980, 9. 5. 1987, V. Furlan leg.
Bela krajina: Semič, Gornja Paka, WL15, 29. 4. 1983, V. Furlan leg.
Novo mesto, Trška gora, WL17, 21. – 22. 5. 1983, 6. 6. 1987, V. Furlan leg.
Kurešček, VL68, 5. 6. 1983, V. Furlan leg.
Unec, VL47, 9. 6. 1983, V. Furlan leg.
Povir, VL16, 16. 5. 1984, 31. 7. 1984, V. Furlan leg.
Divača, VL15, 25. 5. 1985, V. Furlan leg.
Muljava, VL88, 12. 6. 1985, V. Furlan leg.
Senožeče, Gabrče, VL26, 26. 5. 1987, 15. 6. 1987, V. Furlan leg.
Brežec pri Podgorju, VL14, 16. 5. 1990, V. Furlan leg.
Črni kal, Socerb, VL14, 8. 5. 1990, V. Furlan leg.
Črni kal, Praproče, VL14, 12. 7. 1990, V. Furlan leg.
Maribor, Mariborski otok, WM45, 12. 5. 1992, V. Furlan leg.
Radeče, Jagnjenica, WM00, 24. 5.1990, V. Furlan leg.
Kozina, Prešnica, VL14, 22. 6. 1991, V. Furlan leg.
Ljubljana, Ježica, VM60, 12. 6. 1991, V. Furlan leg.
Mrzlica, 1100 m, WM01, 25. 6. 1991, V. Furlan leg.
Loški potok, VL66, 21. 6. 1997, V. Furlan leg.
Loški potok: Retje, VL66, 30. 7. 1998, V. Furlan leg.

***Reduvius personatus*** (Linnaeus, 1758)
Scopoli, 1763: Circa Labacum (= around Ljubljana); Montandon, 1886: Gorica; Gogala & Moder, 1960: Ljubljana; Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Laibach (= Ljubljana), 20. 7. 1929, Staudacher leg.
Ljubljana, VM60, 14. 6. 1950
Ajdovščina, VL18, 1. 8. 1973
Ljubljana, Šiška, VM50, 5. 1989, D. Vrščaj leg.
Kras: Brje pri Komnu, VL07, 1. 8. 1991, A. & M. Gogala leg.
Istra: Koper, Škocjanski zatok, VL04, 19. 6. 2002, A. Kapla leg.
Prekmurje: Gančani, WM96, 1. 6. 1997, S. Gomboc leg.

***Oncocephalus pilicornis*** Reuter, 1882
Montandon, 1886: Gorica (as *O. notatus);* Gogala & Gogala, 1986, 1989, 1994 (as *O. acutangulus)*
Specimens examined:
Nova Gorica, UL99, 4. 6. 1973
Istra: Ankaran, VL04, 20.-30. 6. 1959, Š. Michieli leg.
Istra: Izvir Rižane, VL14, 18. 2. (larvae), imago 24. 5. 1990, 4. 6. 1990, 11. 6. 1990, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 22. 5. 1994, A. & M. Gogala leg.
Istra: Sečovlje, Fontanigge, UL93, 6. 5. 2000, A. Gogala leg.
Istra: Koper, Škocjanski zatok, VL04, 19. 6. 2002, A. Kapla leg.

***Pygolampis bidentata*** (Goeze, 1778)
Montandon, 1886: Gorica; Gogala & Moder, 1960: Ljubljana, Kamn. Bistrica; Gogala & Gogala, 1986, 1989; Protić, 1998: Podčetrtek
Specimens examined:
Styria: Podčetrtek, WM41, 20. 5. 1933, E. Jaeger leg.
Ljubljana, Ježica, VM60, 28. 5. 1933, Staudacher leg.
Laibach (= Ljubljana), 20. 10. 1937, Staudacher leg.
Kamniška Bistrica, VM63, 21. 5. 1950
Ljubljana, Rožnik, VM50, 24. 2. 1954, M. Gogala leg.
Ljubljansko barje: Škofljica, VL69, 19. 5. 1979, A. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 17. 5. 1988, A. & M. Gogala leg.
Bizeljsko, Stara vas, WL59, 21. 4. 2000, A. Gogala leg.
Polhograjsko hrib.: Osredek pri Dobrovi, VM50, 7. 2. 1998 (larva), M. Gogala leg.
Ig, Kremenica, VL68, 9. 5. 2000, S. Brelih leg.
Muljava, VL88, 27. 5. 1982, V. Furlan leg.
Bela krajina: Podzemelj, WL25, 28. 4. 1983, V. Furlan leg.
Bela krajina: Metlika, Primostek, WL25, 28. 4. 1983, V. Furlan leg.

***Coranus griseus*** (Rossi, 1790)
Gogala & Moder, 1960 (as *C. aegyptius):* Koper, Črni Kal, ob Dragonji; Gogala & Gogala, 1989 (as *C. aegyptius),* 1994
Specimens examined:
Istra: Boršt, VL03, 3. 5. 1986, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 29. 9. 1990, A. Gogala leg.
Istra: Strunjan, UL94, 23. 3. 2000, A. Gogala leg.

***Coranus kerzhneri*** Putshkov, 1982
Gogala & Moder, 1960 (as *C. subapterus);* Gogala & Gogala, 1986, 1989 (as *C. subapterus)*
Specimens examined:
Ljubljana, 4. 7. 1954, M. Gogala leg.
Ljubljana, Rožnik, VM50, 27. 9. 1953, M. Gogala leg.

***Coranus tuberculifer*** Reuter, 1881
Gogala & Gogala, 1989, 1994; Protić, 1998
Specimens examined:
Istra: Labor, VL03, 9. 9. 1987, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 3. 10. 1990, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 28. 9. 1996, A. & M. Gogala leg., 28. 6. 2003, A. Gogala leg.
Kras: Tublje pri Komnu, VL07, 18. 5. 2003, A. & M. Gogala leg.

***Nagusta goedelii*** (Kolenati, 1857)
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimen examined:
Styria: Podčetrtek, WM41, 5. 4. 1930 Haus Klafter, E. Jaeger leg.

***Rhynocoris annulatus*** (Linnaeus, 1758)
Gräffe, 1911: Loitsch (= Logatec); Gogala & Moder, 1960: Ljubljana, Šklendrovec, Vremščica; Gogala & Gogala, 1986, 1989, 1994; Protić, 1998: Podčetrtek
Specimens examined:
Ljubljana, Ježica, VM60, 25. 5. 1930, Staudacher leg.
Šklendrovec, WM00, 12. 6. 1932, Staudacher leg.
Laibach (= Ljubljana), 1. 5. 1920, 25. 5. 1944, Staudacher leg.
Ljubljana, 15. 5. 1944, Staudacher leg., 4. 7. 1954, M. Gogala leg.
Bohinj: Ukanc, VM02, 15. 5. 1977, A. & M. Gogala leg.
Slavnik, VL14, 2. 7. 1982, A. & M. Gogala leg.
Ljubljansko barje: Log, Lukovica, VL59, 14. 5. 1983, A. & M. Gogala leg.
Kras: Štorje, VL16, 8. 6. 1983, A. & M. Gogala leg.
Borovnica, Pokojišče, VL48, 19. 8. 1984, A. & M. Gogala leg.
Julijske Alpe: Trenta, VM03, 13. 7. 2001, A. & M. Gogala leg.
Hrastovlje, Podpeč, VL14, 23. 4. 1998, D. Kofol & S. Gomboc leg.
Ilirska Bistrica, Zarečje-Brce, VL34, 31. 5. 1999, S. Brelih leg.
Obrov, Golac, VL24, 8. 6. 2000, S. Brelih leg.
Jesenice, Javorniški rovt, 930 m, VM34, 2. 6. 1979, V. Furlan leg.
Trnovski gozd: Trnovo, 788 m, VL09, 16. 6. 1978, M. Zdešar leg.
Vremščica, 1026 m, VL26, 22. 5. – 4. 6. 1977, V. Furlan leg.
Porezen, VM21, 8. 7. 1976, V. Furlan leg.
Kras: Senadolice, VL16, 22. 5. 1979, M. Zdešar leg.
Kranj, Besnica, VM42, 30. 5. 1982, J. Broder leg.
Črni kal, Črnotiče, VL14, 29. 4. 1990, V. Furlan leg.

***Rhynocoris iracundus*** (Poda, 1761)
Scopoli, 1763; Montandon, 1886: Gorica; Gräffe, 1911: Loitsch (= Logatec); Gogala & Moder, 1960: Ljubljana, Završnica, Bohinj, Divača, Slavnik, Črni Kal; Protić, 1998
*Rhynocoris iracundus iracundus* (Poda, 1761)
Gogala, 1991 (as *R. i. pictus)*
Specimens examined:
Hrastnik, WM01, 23. 5. 2000, A. & M. Gogala leg.
Prekmurje: Muriša, XM25, 22. 5. 2001, A. & M. Gogala leg.
Kum, 1219 m, WM00, 20. 7. 1987, V. Furlan leg.
*"Rhynocoris iracundus amabilis* Dispons in Dispons & Stichel, 1959"
Gogala & Gogala, 1986, 1989, 1994
Specimens examined:
Laibach (= Ljubljana), 1. 7. 1929, Staudacher leg.
Ljubljansko barje: Ig, Kremenica, VL68, 11. 7. 1976, 30. 6. 2002, S. Brelih leg.
Slavnik, VL14, 28. 6. 1982, M. Gogala leg., 1028 m, 9. 6. 1979, V. Furlan leg.
Ljubljansko barje: Log, Lukovica, VL59, 13. 6. 1984, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 5. 5. 1989, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 9. 6. 1990, A. & M. Gogala leg.
Borovnica, Pokojišče, VL48, 24. 6. 1977, A. & M. Gogala leg.
Julijske Alpe: Trenta, VM03, 13. 7. 2001, A. & M. Gogala leg.
Hrpelje, Prešnica, VL14, 23. 5. 1999, S. Brelih leg.
Bistrica ob Sotli, WM50, 18. 5. 2000, S. Brelih leg.
Istra: Zazid, 380 m, VL14, 26. 5. 2003, S. Brelih leg.
Mokrec, VL68, 17. 7. 1976, V. Furlan leg.
Gabrče, VL26, 20. 6. 1982, V. Furlan leg.
Novo mesto, Trška gora, WL17, 21. – 22. 5. 1983, 6. 6. 1987, V. Furlan leg.
Povir, VL16, 31. 7. 1984, V. Furlan leg.
Loški potok, VL66, 31. 7. 1997, V. Furlan leg.
Petrinje, VL14, 3. 6. 1998, M. Zdešar leg.
Note: The colour form, described as the subspecies *amabilis* but then synonymised, is geographically separated in Slovenia. The typical form is present only in eastern Slovenia and *amabilis* in the west and south of the country. Only the colours of the specimen from Kum are in between.

***Rhynocoris rubricus*** (Germar, 1814)
Gogala & Gogala, 1986, 1989; Protić, 1998
Specimens examined:
Istra: Padna, UL93, 16. 6. 1984, A. & M. Gogala leg.
Istra: Koštabona, VL03, 7. 6. 1987, A. & M. Gogala leg.
Kras: Brje pri Komnu, VL07, 28. 5. 1989, A. & M. Gogala leg.
Istra: Dragonja, Stena, UL93, 9. 6. 1990, A. & M. Gogala leg.
Istra: Sočerga, Veli Badin, VL13, 14. 6. 1991, A. & M. Gogala leg.
Istra: Osp, VL14, 13. 6. 1992, A. & M. Gogala leg., 13. 5. 1999, S. Gomboc & D. Kofol leg.
Braniška dol.: Sp. Branica, Čipnje, VL07, 23. 5. 1993, A. & M. Gogala leg.
Istra: Sečovlje, Soline, UL93, 27. 6. 1995, S. Gomboc leg.
Nova Gorica, Sabotin, 560 m, UL99, 27. 5. 1997, D. Kofol leg.
Komen, Branik, VL07, 27. 5. 1998, S. Brelih leg.

**Species omitted from the list**

***Acalypta pulchra*** Štusák, 1961
Péricart & Golub, 1996: Slovenia. Péricart, 1983 lists a record from "ex Yugoslavia": Istria: Mte Maggiore (= Učka), Croatia. Croatia is not listed in Péricart & Golub, 1996, so we can assume that this record was mistakenly attributed to Slovenia.

***Galeatus affinis*** (Herrich-Schaeffer, 1835)
Horváth, 1897: Pazarište (Croatia). Attributed to Slovenia by Péricart, 1983 and Péricart & Golub, 1996

***Tingis trichonota*** (Puton, 1874)
Péricart & Golub, 1996: Slovenia. Péricart, 1983 lists a record from "ex Yugoslavia": Fiume (= Rijeka), Croatia. Croatia is not listed in Péricart & Golub, 1996 so we can assume that this record was mistakenly attributed to Slovenia.

***Myrmedobia coleoptrata*** (Fallén, 1807)
Péricart, 1996a: Slovenia. Péricart (1972) lists two records from "ex Yugoslavia": Fiume (= Rijeka) and Lesina (= Hvar) are in Croatia. We can assume these records were attributed to Slovenia by mistake.

***Acompocoris pygmaeus*** (Fallén, 1807)
Horváth, 1897: Fiume (= Rijeka, Croatia). Attributed to Slovenia by Péricart, 1996b

***Oncocephalus acutangulus*** Reuter, 1882
Gogala & Gogala, 1986, 1989, 1994; Protić, 1998
Misidentification. Records refer to *O. pilicornis*.

***Coranus aegyptius*** (Fabricius, 1775)
Gogala & Moder, 1960; Gogala & Gogala, 1989; Protić, 1998
Misidentification. Records refer to *C. griseus*.

***Coranus subapterus*** (De Geer, 1773)
Gogala & Moder, 1960; Gogala & Gogala, 1986, 1989; Protić, 1998
Misidentification. Records refer to *C. kerzhneri*.

## DISCUSSION

116 species of the infraorder Cimicomorpha without Miridae are listed (Tingidae 49, Microphysidae 1, Nabidae 15, Anthocoridae 29, Cimicidae 2, and Reduviidae 20). Six species were recorded for the first time in Slovenia: *Derephysia sinuatocollis* Puton, 1879, *Dictyla convergens* (Herrich-Schaeffer, 1835), *Nabis riegeri* Kerzhner, 1996, *Brachysteles parvicornis* (Costa, 1847), *Cardiastethus nazarenus* Reuter, 1884, and *Coranus kerzhneri* Putshkov, 1982. The first reliable record for *Nabis ferus* (Linnaeus, 1758) is also reported.

Eight species listed for Slovenian fauna in different works are omitted from the list. Three of them were recorded (for Slovenia) owing to misidentifications: *Oncocephalus acutangulus* Reuter, 1882, *Coranus aegyptius* (Fabricius, 1775), and *Coranus subapterus* (De Geer, 1773). The other five were listed for Slovenia in the Catalogue of the Heteroptera of the Palaearctic Region (Aukema & Rieger, 1996) due to misinterpretation of the localities in Croatia, which were mistakenly attributed to Slovenia. These species are *Acalypta pulchra* Štusák, 1961, *Galeatus affinis* (Herrich-Schaeffer, 1835), *Tingis trichonota* (Puton, 1874), *Myrmedobia coleoptrata* (Fallén, 1807), and *Acompocoris pygmaeus* (Fallén, 1807).

Four species were described from specimens, collected in Slovenia or its bordering region: *Dictyonota strichnocera* Fieber, 1844, *Gardena insignis* Horváth, 1887, *Peirates hybridus* (Scopoli, 1763), and *Monanthia sinuata* Fieber, 1844, known today as *Tingis auriculata* (Costa, 1847).

Several species were reported for Gorica (= Gorice or Görz), which is today situated along the Slovene-Italian border. It is not possible to know on which side of the border they were actually found.

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# HETEROPTERA SLOVENIJE, II: CIMICOMORPHA I

*Andrej GOGALA*

Prirodoslovni muzej Slovenije, SI-1001 Ljubljana, Prešernova 20, p.p. 290

E-mail: agogala@pms-lj.si

*POVZETEK*

*Navedenih je 116 vrst infrareda Cimicomorpha brez družine Miridae. Šest vrst je bilo prvič zabeleženih v Sloveniji:* Derephysia sinuatocollis *Puton, 1879,* Dictyla convergens *(Herrich-Schaeffer, 1835),* Nabis riegeri *Kerzhner, 1996,* Brachysteles parvicornis *(Costa, 1847),* Cardiastethus nazarenus *Reuter, 1884, in* Coranus kerzhneri *Putshkov, 1982. Naveden je tudi prvi zanesljivi podatek za vrsto* Nabis ferus *(Linnaeus, 1758). Osem vrst, navedenih za slovensko favno v različnih delih, je izločenih iz seznama.*

**Ključne besede:** Heteroptera, Cimicomorpha, Tingidae, Microphysidae, Nabidae, Anthocoridae, Cimicidae, Reduviidae, Slovenija, favna

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# KRAŠKE PODTALNE SKALNE OBLIKE

*Tadej SLABE & Martin KNEZ*
Inštitut za raziskovanje krasa ZRC SAZU, SI-6230 Postojna, Titov trg 2
E-mail: izrk@zrc-sazu.si

## *IZVLEČEK*

*Na kraškem skalnem površju, ki je prekrito z naplavinami ali prstjo, nastajajo podtalne skalne oblike, ki nam, povezane v skalni relief, pogosto nazorno razkrivajo način oblikovanja kraškega površja, njegov razvoj in sledi človekovega delovanja. Izsledki so plod preučevanja različnih vrst krasa doma in po svetu. Podtalne skalne oblike nastanejo zaradi pretakanja vode na stiku med skalo in prstjo in zaradi prenikanja vode skozi prst. Posebne oblike pa nastanejo tudi na nivoju prsti, ki obdaja skalo.*

**Ključne besede:** kras, skalna oblika, skalni relief, podtalno oblikovanje skale

# FORME ROCCIOSE SOTTERRANEE DEL CARSO

*SINTESI*

*Nel suolo roccioso del carso, ricoperto di terra e sedimenti alluvionali, si creano forme rocciose sotterranee che, assieme al loro rilievo, riflettono spesso chiaramente la sua origine, l'evoluzione e le tracce dell'intervento umano. Gli esiti dell'indagine fanno seguito ad uno studio sui diversi tipi di suolo carsico in patria e all'estero. Le forme rocciose sotterranee si creano in seguito allo scorrimento dell'acqua tra roccia e terra e all'infiltrazione dell'acqua nel terreno. Forme particolari si creano pure a livello del terreno che ricopre la roccia.*

**Parole chiave:** carso, forma rocciosa, rilievo roccioso, origine sotterranea delle rocce

## UVOD

Skalne oblike, ki so nastale na kraškem površju, pokritem s prstjo ali naplavino, imenujemo podtalne.

Prst ali različne naplavine, ki povsem ali deloma prekrivajo karbonatne kamnine, vplivajo na oblikovanje skale. Voda, ki se pretaka na stiku med pokrovom in kamnino, oblikuje podtalne žlebove in podtalne fasete. Posebej lahko izločimo drobne oblike na najbolj prepustnih stikih med skalo in prstjo, kjer voda prenaša zrna naplavine in jih odlaga na skali. To so drobno razčlenjeni žlebovi, vdolbinice, poličke in konice. Z vodo, ki prenika skozi prst, nastanejo vdolbine. Voda, ki priteka na nivo prsti, ki obdaja skalo, dolbe pol-zvonove in zajede. Svojevrstne skalne oblike nastanejo tudi zaradi nihanja gladine podzemeljske vode.

Podtalno razčlenjenost skale, ki je predvsem posledica sestave kamnine, njene razpokanosti in skladovitosti, torej mest šibkosti v kamnini, ločujemo od podtalnih skalnih oblik, ki jih ustvarijo našteti dejavniki.

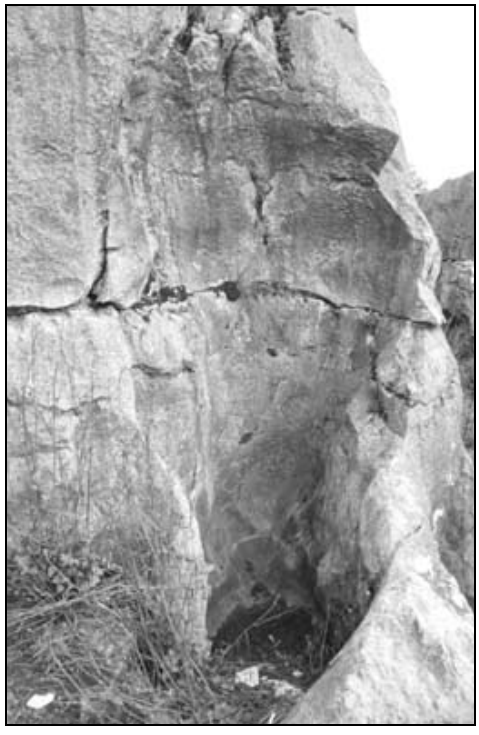
Skala je zaradi razmeroma enakomernega raztapljanja kamnine pod prstjo in naplavino zaobljena, takšne so tudi podtalne skalne oblike, površina skale pa je, gledano s prostim očesom, razmeroma gladka, oziroma na pestro sestavljenih ali rekristaliziranih karbonatih značilno hrapava. V teh značilnosti se ne ujemajo le najmanjše podtalne skalne oblike. Pod velikimi povečavami pa je podtalna skalna površina zaradi enakomernega razjedanja zrnate kamnine praviloma izrazito drobno hrapava (Slabe, 1994).

Podtalne skalne oblike je kot del škrapelj leta 1960 opisal Bögli. Podtalne žlebove izpostavi Williams (1966). Pomen in način tovrstnega oblikovanja skale je predstavil Gams (1971). Predstavi jih tudi Sweeting (1972). Jennings (1973) podtalne skalne oblike deli na tiste, ki nastanejo z raztapljanjem delno ali povsem pokritega apnenca. V prvo skupino uvršča tudi podtalne zajede, v drugo pa globoke podtalne vdolbine. Nicod (1976) predstavi podtalno oblikovanje skale v Sredozemlju. Podtalne fasete opiše Sauro (1976). Podtalne skalne oblike, predvsem žlebovi, so nazorno predstavljeni v atlasu skalnih oblik, ki sta ga pripravila Perna & Sauro (1978). Bögli (1981) opisuje skalne oblike, ki so nastale pod tlemi in jih imenuje Rundkarren. Fabre & Nicod (1982) združita znanje o podtalnem oblikovanju skale. Pomen oblikovanja skale pod prstjo opredeli Trudgill (1985) in opiše podtalne vdolbine (Trudgill, 1986). White (1988) pri delitvi škrapelj izloči tudi tiste, ki so bile pokrite s prstjo. Zaradi pretakanja vode nastanejo zaobljeni žlebovi, posledica pretakanja vode in razjedanja skale pa so luknje. Ford & Williams (1989) opišeta tudi majhne luknje, podtalne vdolbine in žlebove, ki nastajajo pod preperelino. Škraplje, ki nastanejo zaradi pretakanja vode skozi prst, opiše tudi Ginés (1990, 1996) in našteje podtalne oblike: luknje in vdolbine. Pomen podtalnega oblikovanja skale poudarjajo tudi preučevalci lunanskega kamnitega gozda, ki ga opisujejo kot obliko pokritega krasa (Chen Zhi Ping *et al.*, 1983; Maire *et al.*, 1991; Sweeting, 1995; Slabe, 1999; Knez & Slabe, 2001a, b, 2002). Skala je pogosto poraščena ali prepletena s koreninami (Jakucs, 1977; Ollier, 1984). Tovrstnih sledi ne štejemo neposredno med podtalne skalne oblike, seveda pa rastje vpliva na oblikovanje opisanega podtalnega skalnega reliefa.

## PODTALNE SKALNE OBLIKE, KI NASTANEJO ZARADI PRETAKANJA VODE NA STIKU MED SKALO IN PRSTJO ALI NAPLAVINO

### Podtalni žlebovi

Podtalni žlebovi nastanejo zaradi strnjenega pretakanja vode ob stiku s prstjo. Največji (Sl. 1) praviloma nastanejo, ko voda zateka za navpični ali strmi stik. Premer velikih, praviloma navpičnih in posameznih žlebov meri od 20 cm do meter in več. Ob razpokah, kjer so žlebovi najbolj pogosti, so globlji, ob najbolj izrazitih lahko nastane podtalno brezno. Velikost premera je lahko v istem žlebu različna. Globlje pod prstjo in naplavino so veliki žlebovi pogosto ožji. Kamnina se torej najhitreje raztaplja ob zgornjem delu prsti in naplavine. Izraziti in raznovrstni žlebovi so v lunanskem kamnitem gozdu. Razširitve v podtalnih žlebovih Song Linhua



***Sl. 1: Razgaljeni podtalni žleb. Lunanski kamniti gozdovi, Yunnan, Kitajska.***
***Fig. 1: Denuded subsoil channel. Lunan stone forest, Yunnan, China.***

(1986) pojasnjuje z mešanjem voda, ki polzijo ob stiku, in tistih, ki prenikajo skozi prst. Manjši podtalni žlebovi s 5 do 20 cm premera prepredajo steno pod različnimi koti in so pogosto vijugasti. So enakomerno široki po vsej dolžini ali pa širši na stiku z drugimi žlebovi. Lahko so povezani v mrežo. Najbolj vijugasti so praviloma najmanjši žlebovi, katerih premer doseže le 5 cm. Na njihov nastanek bolj izrazito vplivata tudi sestava in razpokanost kamnine, na kateri se oblikujejo.

Podtalni žlebovi nastanejo predvsem z vlaženjem prsti in naplavine na prepustnem stiku s skalo in manjkrat z izrazitimi manjšimi tokovi. Na to kaže tudi njihova oblika in pogosta razčlenjenost z vodoravnimi zajedami. Pogosto pa na dnu žlebov med skalo in ilovico nastanejo manjše cevi, ki imajo do 1 cm velik premer in skozi katere se pretaka voda. Ob stiku z vlažno prstjo je raztapljanje kamnine bolj izrazito in dolgotrajno. Velikost in obliko žlebov narekujeta, poleg kamnine, predvsem prepustnost stika s prstjo in količina vode, ki priteka na stik. Kot kaže, nastajajo ob slabše prepustnem stiku manjši in bolj vijugasti žlebovi. Vrsta stika med steno in prstjo je lahko tu in tam različna oziroma se lahko spremeni. Na stenah večjih žlebov so zato lahko vijugasti žlebiči. Ob slabše prepustnih stikih so podtalni žlebovi večji ob nivoju naplavine in prsti, pod njim pa se hitro zožijo. Tudi Gams (1997) ugotavlja povezanost med rastjo podtalnih votlin in prepustnostjo njihove zapolnitve. V zgornjem delu, torej tik pod površjem, imajo takšni žlebovi največkrat izrazita lijakasta ustja, katerih premer lahko presega 1 meter.

Podtalni žlebovi so tudi na apnencu, ko je ta v stiku s flišem in na stenah starih jam brez stropa, ki so zapolnjene z naplavinami. Kadar voda na stik priteka skozi ozko špranjo v kamnini, se žleb največkrat razširi šele več deset cm pod površjem. Pod ozkim ustjem so ponekod tudi podtalne fasete.

Tudi na manj ali bolj položni skali, ki jo prekriva prst, nastanejo žlebovi (Sl. 2) s polkrožnim dnom (Sweeting, 1972; Perna & Sauro, 1978; Trudgill, 1985). So posledica združevanja vode, ki prenika skozi prst. Na strmih površinah so lahko vzporedni (Williams, 1966), lahko bi govorili o podtalnih žlebičih, saj se voda, ki prenika skozi prst, enakomerno pretaka po vsej površini. Na položnih površinah skale pa so povezani v »vejnato« mrežo (Sl. 3). Globlji žlebovi imajo lahko na stenah manjše podtalne žlebiče. Svojevrstni žlebovi, ki imajo prečne prereze polkrožne ali omega oblike, nastanejo na dnu špranj med kamnitimi stebri ali zobmi, kjer se izklinjajo razpoke.

Posebni žlebovi (Sweeting, 1972) se oblikujejo, ko so le ti zapolnjeni s prstjo ali pa je prekrito njihovo dno, okoli pa je skala razgaljena. Največkrat imajo značilno obliko na glavo obrnjene grške črke omega. Lahko so nadstropni. Zaradi nižanja nivoja prsti se je ta zadržala le na dnu žlebov in jih zato poglobila in razširila. Žlebovi vodijo tudi iz podtalnih vdolbin, torej na mestih stekanja vode. Pogosto so se razvili iz podtalnih cevi, ki so se razkrile, ko so razpadli zgornji skladi kamnine. Slednji se kot podtalni žlebovi oblikujejo od trenutka, ko je nivo prsti, ki obdaja stebre, nižje od žlebov. Pogosto je moč slediti prehodom iz žlebov, ki so nastali na skali, povsem prekriti s prstjo v tiste, ko so prekriti le žlebovi. Po razgaljenju, ko v njih ni več prsti, jih preoblikuje de-

***Sl. 2: Podtalni žlebovi. Matarsko podolje.***
***Fig. 2: Subsoil channels. Materija lowland.***

***Sl. 3: Mreža podtalnih žlebov. Lunanski kamniti gozdovi, Yunnan, Kitajska.***
***Fig. 3: Network of subsoil channels. Lunan stone forest, Yunnan, China.***

***Sl. 4: Podtalne anastomoze na bazalnem konglomeratu v flišu nad Kastelcem, odkrite med graditvijo avtoceste.***
***Fig. 4: Subsoil anastomoses on basal conglomerate in flysch near Kastelec, discovered during motorway construction.***

ževnica. Podtalni žlebovi začnejo preoblikovati skalo, tudi dežne skalne oblike, ob ponovnem zaraščanju nekoč razkritega krasa (Jennings, 1973). To je značilno tudi za klasični Kras, kjer skalo vse bolj izrazito prekriva preperelina ali debela plast mahu.

V območjih lokalno zalitih con lahko nastanejo nadnaplavinski žlebovi in anastomoze (Slabe, 1992). So tudi značilnost spodnjih ploskev bazalnih karbonatnih konglomeratov v flišu (Sl. 4).

### Podtalne fasete

Podtalne fasete nastanejo zaradi pretakanja vode ob vzdolžno prepustnem stiku kamnine s prstjo. So podtalne vdolbine, povezane v mrežo. Njihovi premeri so veliki od 15 do 50 cm. So plitke, največkrat nekoliko globlje na zgornji strani. Praviloma so na previsnih površinah skale. Na izrazito previsnih površinah so lahko luskinasto nanizane druga nad drugo (Sl. 5). Spodnji deli, ki so ožji, štrlijo iz sten.

Podtalne fasete lahko opazujemo ob izrazitih razpokah, ob katerih nastanejo špranje, zapolnjene s prstjo. So tudi značilnost previsnih sten stebrov v kamnitih gozdovih. Tudi obod podtalnih zajed je pod tlemi pogosto razčlenjen s podtalnimi fasetami. Do zgornjih podtalnih faset ponekod vodijo žlebovi. Te so večje.

Ob izrazitih razpokah, ki prepredajo stene, ali ob lezikah podtalne fasete praviloma ne nastanejo, temveč se ob njih razvije polkrožen žleb.

Obnaplavinske vdolbine so pogoste tudi na stenah jam, ki jih zapolnjuje drobnozrnata naplavina.

### Skalni relief podtalnih škrapelj, ki so občasno poplavljene

Vrhovi škrapelj (Sl. 6), ki jih občasno dosega podtalna voda in se v celoti oblikujejo pod tlemi, so priostreni. V zgornjem delu prevladuje razmeroma gladka, za oblikovanje pod prstjo in drobnozrnatimi naplavinami značilna skala. V spodnjem delu škrapelj so najbolj izrazite podtalne zajede. Večje in vodoravne dosežejo meter premera, manjše so ena nad drugo. Polkotličaste zajede so zaključki navpičnih podtalnih žle-

***Sl. 5: Podtalne fasete. Lunanski kamniti gozdovi, Yunnan, Kitajska.***
***Fig. 5: Subsoil scallops. Lunan stone forest, Yunnan, China.***

***Sl. 6: Občasno poplavljene podtalne škraplje. Uvala pri Biču na Dolenjskem.***
***Fig. 6: Periodically flooded subsoil karren. Uvala at Bič, Dolenjska region.***

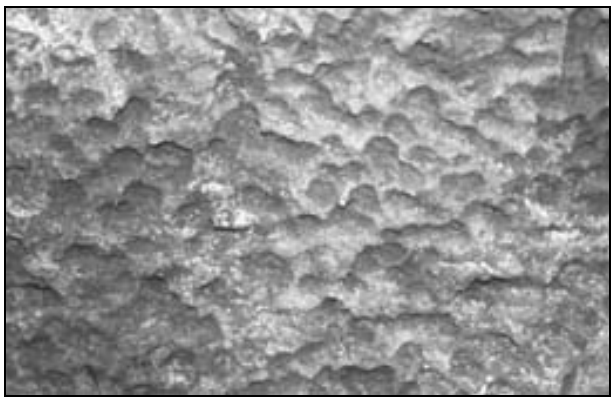
bov, ki so nastali ob najbolj prevodnih poteh. Posamezni vrhovi podtalnih zob nad najbolj izrazitimi zajedami so gobasti. Podtalne žlebove na teh škrapljah lahko razdelimo na navpične in vodoravne. Prvi so prevodniki nihajoče podtalne vode ob najbolj prevodnih poteh. Drugi, ki prepredajo položnejše, tudi večje površine skale, pa se sooblikujejo tudi z vlago, ki se v njih zadrži najdlje časa, tudi po znižanju gladine podzemeljske vode. Podobno se ob šibkostih v kamnini, največkrat so to drobne razpoke, oblikujejo podtalne vdolbine, ki sčasoma lahko prerastejo v cevi. Med vdolbinami in žlebovi so torej podtalne cevi, ki prepredajo skalo v različnih naklonih.

Tovrstno oblikovanje podtalnih škrapelj ponazarja tudi poskus z mavčnimi stebrički, ki smo jih prekrili s prstjo in nato izpostavili umetnemu dežju. Voda je na spodnji strani odtekala iz modela. Zgornji del stebričkov je oblikovala voda, ki je razpršeno prenikala skozi prst, spodnji pa se je oblikoval v lokalno zaliti coni. Odtok vode je bil namreč prepočasen in voda je zato zalila spodnji del modela.

Če strnemo, lahko iz oblike škrapelj in njihovega skalnega reliefa izluščimo dva prevladujoča načina njihovega oblikovanja. Poseben pečat jim dajejo skalne oblike, ki so sled pogostega nihanja gladine podtalne vode, ki škraplje poplavlja od spodaj. V času nizkih podtalnih voda pa jih oblikuje voda, ki občasno in razpršeno prenika iz površja skozi prst in enakomerno polzi po skali navzdol. Dalj časa se zadrži v podtalnih vdolbinah in položnih žlebovih ter tudi ob manj prepustnih stikih kamnine z naplavino, ki jih obdaja.

### Drobna podtalna razčlenjenost skale

Stene špranj, skozi katere voda prenaša tudi prst, a jih ne zapolni povsem, in vrtač, ki so rahlo prekrite s prstjo, so pogosto razčlenjene s svojevrstnimi vdolbinicami, previsi pa s stropnimi konicami. Na položnejših odsekih v takih razmerah skalo razčlenjujejo poličke. Vdolbinice (Sl. 7) so polkrogelne ali podolgovate in stopničasto nanizane. Njihov premer je od 0,5 do 2 cm. Največje nastanejo iz več manjših. V vseh primerih so skalne oblike povezane v mrežo. Njihov nastanek in oblika sta predvsem posledica značilnosti sestave kamnine iz osnovnih delcev ter nagiba skale, po kateri polzi voda. Tudi manj izraziti žlebovi, ki pogosto nastanejo v špranjah, so v takšnih razmerah drobno razčlenjeni z vdolbinicami. Kaže, da voda, ki polzi po skali, prenaša prst in jo na posameznih mestih, v vdolbinicah na navpičnih površinah, na poličkah na položnih in na konicah v previsih, odlaga. Vlažna naplavina v vdolbinicah lahko bolj učinkovito razjeda skalo. Voda se namreč zbira v naplavini in se dlje časa zadržuje v njej. Na nagnjenih površinah voda odlaga naplavino na najbolj položnih odsekih. Ščiti jih pred korozijo, ob njej pa se skala hitreje razjeda in zato členi v poličke. Na previsnih površinah se naplavina nabira na konicah in jih ščiti pred raztapljanjem.



***Sl. 7: Podtalne vdolbinice. Stena vrtače, razkrita med graditvijo avtoceste pri Kozini.***
***Fig. 7: Subsoil cups. Dolina wall, discovered during motorway construction near Kozina.***

### Podtalne cevi

Skalo pod tlemi pogosto prepredajo različno velike votline (Sl. 8), torej kraške votline, ki so med oblikovanjem zapolnjene z naplavino ali prstjo. So različnih velikosti in oblik. Večje so razčlenjene v skalni relief z nadnaplavinskimi in podnaplavinskimi žlebovi.

Manjše votline (Gams, 1971), katerih premer meri od cm do dm, votlijo skalo v različnih smereh in so pogosto povezane v splet. Večinoma so nastale na izrazito razpokani ali porozni kamnini. Pri njihovem oblikovanju pogosto pomembno sodeluje tudi rastje.

***Sl. 8: Podtalna zajeda z votlino. Pu Chao Chun kamniti gozd, Yunnan, Kitajska.***
***Fig. 8: Subsoil notch with tube. Pu Chao Chun stone forest, Yunnan, China.***

## SKALNE OBLIKE, KI NASTANEJO ZARADI PRITEKANJA VODE NA ZGORNJI NIVO PRSTI ALI NAPLAVINE

### Podtalne zajede

Nastanejo zaradi razjedanja skale ob dolgotrajnem nivoju naplavine ali prsti, ki jo obdaja (Sl. 8). Do stika priteka voda po večji površini, ga bolj ali manj izrazito razjeda, nato pa zateka med kamnino in prst. Manjše podtalne zajede s premerom od 10 do 20 cm imajo obliko polkrožnih vodoravnih žlebov, le njihovi zgornji robovi so največkrat bolj ostri, spodnji pa zaobljeni. Večje podtalne zajede (Jennings, 1973; Ollier, 1984; Waltham, 1984; Ford *et al.*, 1997) so meter in več globoko zajedene v skalo, pogoste so tudi v lunanskem kamnitem gozdu, kjer so do meter visoke. Spodnji del zajed je spodjeden. Skala je bila namreč podvržena hitrejšemu, dolgotrajnemu raztapljanju pod vlažnimi tlemi in je zato tudi zaobljena in gladka. Spodnja ploskev zajede je vodoravna, zgornja pa polkrožno povija proti spodnji. Zgornji del zajede je preoblikovan zaradi polzenja vode po skali navzdol. Sprva nastanejo torej manjše polkrožne zajede, nato pa ob počasnem nižanju nivoja naplavine lahko rastejo v vse večje. Zajede je moč opaziti na različnih višinah hitro in skokovito razgaljenih skal. Manjše in izpostavljene zajede so bolj, velike pa manj izrazito preoblikovane z deževnico. Voda, ki jih oblikuje, pogosto zateka med kamnino in prst pod njimi ter oblikuje podtalne žlebove ali fasete.

Opisane oblike ločimo od zajed, ki nastanejo zaradi pogosto hitrejšega raztapljanja kamnine ob vodoravnih lezikah. Slednje so praviloma ožje in glede na premer odprtine največkrat razmeroma globoke.

### Podtalni polzvonovi

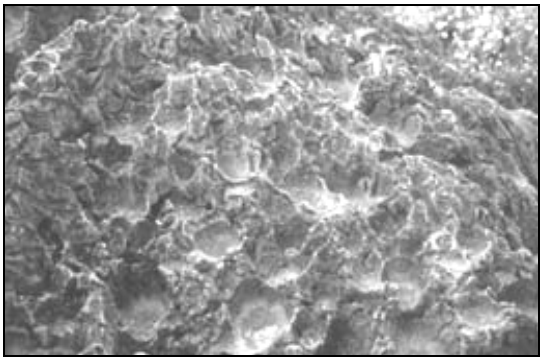
Polzvonovi (Sl. 9) nastanejo pod žlebovi, ki do naplavine ali prsti, ki obdaja skalo, strnjeno vodijo večjo količino vode. Stik ni dovolj prevoden za vso vodo, ki ga doseže. Izraziti in veliki so v lunanskih kamnitih gozdovih. Nad prstjo ali naplavino so značilnih zvonastih in polzvonastih oblik. Njihova oblika in velikost sta povezani s količino vode, ki priteče do prsti, prepustnostjo stika med skalo in prstjo in s hitrostjo nižanja nivoja prsti ali naplavine. Zgornji del žleba je lahko, kadar se je oblikoval ob izraziti razpoki, tudi cev, stena je prežrta le ob razširitvi. Stene velikih zvonov so tik pod tlemi lahko razčlenjene s podolgovatimi podtalnimi vdolbinami, ki dosežejo do meter premera. Globlje pod tlemi se zvonaste razširitve največkrat postopoma zožujejo v podtalni žleb.

***Sl. 9: Razgaljeni podtalni polzvon. Shilin kamniti gozd, Yunnan, Kitajska.***
***Fig. 9: Denuded subsoil half-bell. Shilin stone forest, Yunnan, China.***

## SKALNE OBLIKE, KI NASTANEJO ZARADI PRENIKANJA VODE SKOZI PRST IN NAPLAVINO

### Podtalne vdolbine

Pod tanjšo plastjo porozne prsti, ki ponekod ali v celoti prekriva kamnino, nastanejo na vodoravnih površinah vdolbinice in vdolbine (Sl. 10). Prve imajo premer od 1 do 5 cm, druge pa so večje. Nastanejo zaradi prenikanja vode skozi prst do skale. Praviloma se oblikujejo na mestih šibkosti v skali. Voda vlaži prst v vdolbinicah in jih, kot je to pravilo, ko skalo obdaja drobnozrnata naplavina ali prst, zaobljeno povečuje. Njihov prečni



***Sl. 10: Podtalne vdolbinice. Shilin kamniti gozd, Yunnan, Kitajska.***
***Fig. 10: Subsoil cups. Shilin stone forest, Yunnan, China.***

prerez je zato okrogel, ob razpokah pa elipsast. Vdolbine so največkrat druga ob drugi ali pa že povezane. Iz podtalnih vdolbin se zlasti na razpokani ali porozni skali lahko razvijejo podtalne luknje, majhne votline.

Iz podtalnih vdolbin, ki so na vodoravnih površinah, lahko nastanejo, če se skala razgali, tudi škavnice. Razvoj prikazuje Gams (1971), ki tovrstne podtalne vdolbine imenuje pokrite škavnice.

Posebne podtalne vdolbine nastajajo pod novo nastajajočo preperelino. Ob zaraščanju golega površja se na skalah kopiči razpadlo rastje, ki zadržuje vlago in pospešuje razjedanje skale. Vdolbine so sprva plitke in imajo položne stene. Njihovi premeri so veliki od nekaj cm do več dm. Nekatere imajo žlebove, po katerih se iz njih preliva presežna voda. Na nagnjenih površinah je njihov zgornji del polkrožen in širok, navzdol se ožijo. Vdolbine nastajajo tudi pod mahom, lišaji ali algami, ki tu in tam prekrijejo skalo.

V to poglavje bi lahko sodili tudi podtalni žlebovi, ki nastanejo zaradi stekanja in pretakanje vode, prenikajoče skozi prst. Zaradi značilnega oblikovanja pa so njihovi opisi pridruženi oblikam, ki nastanejo zaradi pretakanja vode ob stiku skale in prsti.

### Površina podtalnih skalnih oblik

Površina podtalnih skalnih oblik (Sl. 2) je, če je kamnina dokaj enakomerno sestavljena, praviloma gladka. Z velikimi povečavami (več tisočkratnimi) vrstičnega elektronskega mikroskopa pa ugotavljamo, da je drobno razčlenjena, kar je posledica hitrejšega raztapljanja skale ob šibkostih v kamnini, na stikih različnih delcev, ki jo sestavljajo. Na gladkost oziroma hrapavost kamnine vpliva njena sestava in pretrtost. Počasneje topni delci, ki lahko izrazito štrlijo iz skalne površine, na njej ostajajo (Slabe, 1994), čeprav so zaradi večje površine, ki je izpostavljena, izpostavljeni razmeroma hitrejšemu raztapljanju. Trudgill (1985) je meril hrapavost skalne površine in na podlagi njene luknjičavosti in višine iz nje štrlečih fosilov in roženca ugotavljal stopnjo razjedenosti kamnine.

### ZAKLJUČEK

Naplavine in prsti, ki v različnih debelinah prekrivajo skalo, so različnih sestav. To vpliva na njihovo prepustnost in prepustnost stika med njimi in skalo ter na način pretakanja vode ob stiku ali skozi njih. O nastanku skalnih oblik in njihovi podobi ter površini soodloča kamnina s svojo sestavo, plastovitostjo in pretrtostjo.

Podtalne skalne oblike so razločen in poveden znak oblikovanja skale pod tlemi in pogosto tudi pomembna sled razvoja kraškega površja in njegove izrabe.

## KARST SUBSOIL ROCK FORMS

*Tadej SLABE & Martin KNEZ*
Karst Research Institute ZRC SAZU, SI-6230 Postojna, Titov trg 2
E-mail: izrk@zrc-sazu.si

*SUMMARY*

*Shapes created on karst surfaces, covered by soil or sediment, are called "subsoil rock forms." Soil or various types of sediment that completely or partially cover carbonate rock influence the shaping of the rock. Water flowing along the contact between the cover and the rock creates subsoil channels (Table) and subsoil scallops. We can distinguish tiny forms at the most permeable contact between rock and soil where the water carries particles of sediment and deposits them on the rock. These include finely dissected channels, small cups, steps, and small pendants. Water that percolates through the soil forms subsoil cups and solution pipes. When so much water flows down the rock to the soil or sediment that it cannot all flow away rapidly between the rock face and the soil or sediment, it carves out half-bells and notches. Unique rock forms also occur due to the oscillation of the level of the water table.*

*We distinguish subsoil dissection of the rock that is mostly a consequence of the rock structure and its fissuring and stratification, that is, weak spots in the rock, from the subsoil rock forms created by the factors mentioned above.*

*Due to the relatively even dissolving of rock under soil and sediment, the rock is rounded as are the subsoil rock forms, and the surface of the rock is relatively smooth to the naked eye or characteristically rough on diversely-structured or recrystalized carbonate rock. Only the smallest subsoil rock forms deviate from these characteristics. Under great magnification, the subsoil rock surface is, as a rule, distinctly finely rough due to the even corrosion of the grained rock.*

*The sediments and soils covering rock in layers of varying thickness have different structures. This influences their permeability and the permeability of the contact between them and the rock and the manner in which water flows through them and along the contact. The rock and its composition, stratification, and fracturedness determine the development of rock forms and their appearance and surface.*

*Subsoil rock forms are a distinct and indicative sign of the formation of rock under the ground and often an important trace of the development of the karst surface and its use.*

**Key words:** karst, rock form, rock relief, subsoil shaping of the rock

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**OCENE**
***RECENSIONI***
***REVIEWS***

Egidio Trainito: ATLANTE DI FLORA & FAUNA DEL MEDITERRANEO: GUIDA ALL'AMBIENTE SOMMERSO


Lansko pomlad je izšel pri naših zahodnih sosedih še en priročnik za prepoznavanje flore in favne Sredozemskega morja. Avtor knjige, ki je tudi izkušen potapljač in podvodni fotograf, se že vrsto let ukvarja z novinarstvom in njegove prispevke redno objavljajo v več italijanskih potapljaških revijah. Pa vendar se ta "še en priročnik" precej razlikuje od drugih. Že po zunanjem videzu lahko opazimo, da je knjiga namenjena uporabi na terenu. Listi so namreč vpeti v obročke, kar bralcu omogoča, da knjigo popolnoma odpre. Format knjige je ravno pravšen, da jo lahko nosimo s sabo in listamo po njej brez težav. Žal pa platnice niso plastificirane, kar bi bilo zelo koristno pri uporabi na morju.

Vsebinsko se knjiga razlikuje od drugih predvsem po izjemno velikem številu kakovostnih fotografij, prek 900. Vsaka omenjena vrsta, več kot 800, je namreč predstavljena z eno ali več fotografijami. Na to lastnost priročnika nas opozarja tudi avtor v uvodu. S tem je hotel omogočiti prepoznavanje vrst tudi tistim potapljačem in drugim ljubiteljem morja, ki so manj podkovani na področju morske biologije.

Pri določevanju vrst je avtorju pomagalo več strokovnjakov. Ker pa je bilo delo opravljeno le na podlagi predloženih fotografij, je zaradi negotovosti pod nekaterimi slikami poleg imena vrste tudi vprašaj. Večina fotografij je avtorjevih, vendar so jih veliko prispevali tudi drugi, med njimi tudi Marjan Richter, eden izmed pionirjev slovenske podvodne fotografije.

V uvodu lahko preberemo že skoraj klasičen opis Sredozemskega morja z vsemi njegovimi fizičnimi lastnostmi, kot so površina, prostornina, globina, tokovi, temperatura, slanost in še kaj. Tudi kratkega opisa zgodovine tega morja ne manjka. Pa vendar sem v nasprotju z drugimi tovrstnimi priročniki prvič zasledil tudi opis tujerodnih in tako imenovanih lesepskih vrst, katerih število se v Sredozemskem morju iz leta v leto počasi veča. Vzroki prihoda novih vrst so človeška dejavnost (balastne vode čezoceank, marikultura) in globalne klimatske spremembe. Sledi splošen opis ekologije morja, kot so prehrambna veriga in razdelitev morskih organizmov glede na ožje okolje, v katerem živijo. Uvod se konča z razlago o ustaljeni razdelitvi organizmov v kraljestva in različna debla *(phyla).*

Pa smo že pri jedru priročnika, zaradi katerega bo knjiga pritegnila pozornost vsakega ljubitelja morskih lepot. Vsakemu deblu je posvečeno eno poglavje, ki se začne s kratkim opisom glavnih lastnosti pripadajočih organizmov tistega debla. Nato sledi lepo število fotografij. Pod vsako lahko preberemo navadno italijansko in znanstveno ime fotografirane vrste. Ravno te slike pripomorejo k lažjemu prepoznavanje vrst. Sicer bodo strokovnjaki morali poseči še po kakšnem bolj specializiranem gradivu za natančno določevanje. A kot sem že omenil, je priročnik namenjen predvsem navadnim ljubiteljem morja in terenskemu delu, ko pač ni mogoče imeti pri roki strokovne literature. Mene osebno je še posebej pritegnil tisti del, ki obravnava gole polže, saj doslej še nisem zasledil v nobeni knjigi tako velikega števila fotografij različnih vrst teh izjemno lepih mehkužcev. Enako bi lahko rekel tudi za ožigalkarje in rake.

Na koncu knjige je zemljevid Sredozemskega morja z vsemi obstoječimi zavarovanimi območji. Za Slovenijo sta omenjena Naravni rezervat Strunjan in Naravni spomenik Debeli rtič. Sledi kazalo latinskih imen, seznam ključnih besed in bibliografija ter kratek seznam koristnih povezav na svetovnem spletu.

Zaradi preglednosti in pestrosti fotografij je priročnik vsekakor zelo zanimiv za vsakega potapljača, športnega ribiča in ljubitelja morskega življa nasploh. Prav bo prišel tudi študentom in strokovnjakom vsaj pri začetnem določevanju vrst.

**Samo Alajbegović**

## DELO NAŠIH ZAVODOV IN DRUŠTEV
## *ATTIVITÀ DEI NOSTRI ISTITUTI E DELLE NOSTRE SOCIETÀ*
## *ACTIVITIES BY OUR INSTITUTIONS AND ASSOCIATIONS*

### OHRANJANJE KRAŠKIH TRAVNIKOV TER RASTLINSKIH IN ŽIVALSKIH VRST

Kraški rob, apnenčasti prelom na meji med celinskim in primorskim delom Slovenije, ponuja eno najbolj veličastnih vedut slovenske pokrajine. Prelom, ki ločuje kraški svet od flišnega, pa označuje tudi izjemna pestrost habitatov kot tudi rastlinskih in živalskih vrst. V kulturni krajini se med gozdom prepletajo suha kraška travišča, apnenčaste stene in melišča, poživljajo pa jo kali, posebnost kraške kulturne in naravne dediščine. Tu so se ohranile redke in ogrožene rastlinske in živalske vrste.

Na svetu je vsega nekaj sto rastlin vrste Tommasinijeva popkoresa, in prav na Kraškem robu jo najdemo v največjem številu. Kar 7 vrst metuljev Kraškega roba je uvrščenih na sezname najbolj ogroženih vrst v Evropi. Ti seznami so dodatek ključnih naravovarstvenih direktiv EU (direktive imajo v EU težo zakona), na osnovi katerih so države članice EU (od maja 2004 tudi Slovenija) dolžne razglašati posebej varovana območja, znana kot NATURA 2000 (med ta območja se je uvrstilo tudi območje Kraškega roba). S temi direktivami ("ptičja" in "habitatna" direktiva) je varstvo narave prvič v Evropi povsem izenačeno z drugimi sektorji, kot so npr. kmetijstvo, energetika, promet, ki so v preteklosti pogosto uveljavljali svoje "družbeno-razvojne" interese na račun okolja, narave in krajine, pa tudi zahtev lokalnega prebivalstva.

Za ohranitev kulturne krajine in naravnih danosti Kraškega roba se je v okviru Univerze na Primorskem, Znanstveno-raziskovalnega središča Koper, oktobra 2002 začel uresničevati projekt LIFE-Narava *"Ohranitev in varstvo ogroženih habitatov/vrst na območju Kraškega roba",* ki bo trajal do oktobra 2005. Partnerji pri projektu so Ministrstvo za okolje, prostor in energijo, Mestna občina Koper, Zavod RS za varstvo narave-OE Piran, Center za kartografijo favne in flore ter provinca Valencia v Španiji. Projekt, ki je vreden skoraj pol milijona evrov, v višini 75% financira EU v okviru programa LIFE-Narava. LIFE-Narava je finančni instrument, ki podpira okoljsko politiko EU.

Projekt je modelni prikaz novega tipa zavarovanja naravovarstveno najpomembnejših enot – pogodbeno varstvo z zasebnimi lastniki, model vzpostavitve mreže mikro-rezervatov ter model financiranja trajnostne rabe teh območij z uporabo finančnih mehanizmov EU.

Cilj projekta je ohranitev naravnih danosti in kulturne krajine ter izboljšanje razmer za lokalno prebivalstvo, ki bo v okviru projekta uresničen z ohranitvijo ogroženih habitatov, rastlinskih in živalskih vrst ter s podporo razvoju Kraškega roba kot območja, predvidenega za naravoslovni turizem. Med glavnimi dejavniki, ki ogrožajo obstoj značilnih suhih travišč, melišč in kalov ter s tem posledično vplivajo na izginjanje značilnih rastlinskih in živalskih vrst, so opuščanje tradicionalne rabe, zaraščanje, intenziviranje kmetijstva, uničevanje mejic in kalov ter nizka naravovarstvena zavest.

Območje, vključeno v projekt LIFE-Narava, pokriva približno 7000 ha in leži na skrajnem jugozahodnem delu Slovenije. Na severu je območje omejeno z državno mejo z Italijo, na vzhodu z mejo občine Koper, na jugu pa z državno mejo s Hrvaško. Na vzhodni strani poteka meja od hrvaške meje po cesti prek Movraža, Hrastovelj, Črnega kala in Ospa vse do italijanske meje.

*Moehringia tommasiniana* ***(Foto/Photo: M. Kaligarič).***

***Ciljni habitati so naslednji:***

6210 – submediteransko-ilirska suha in polsuha travišča, ki jih glede na vrstno sestavo in ekološke razmere delimo na suhe kamnite pašnike in na polsuhe bazifilne travnike. Travniki so razviti na globlji, bolj hranljivi podlagi na flišu ali pa na apnencu, pašniki pa na skeletnih tleh le na apnencu; 8160 – zahodnosredozemska in druga termofilna melišča; 8210 – karbonatna skalnata pobočja z vegetacijo skalnih razpok, in 3170 – kali.

***Ciljne vrste so naslednje:***

ena rastlinska vrsta (Tommasinijeva popkoresa *Moehringia tommasiniana),* pet dvoživk (veliki pupek *Triturus carnifex,* hribski urh *Bombina variegata,* zelena krastača *Bufo viridis,* zelena rega *Hyla arborea,* rosnica *Rana dalmatina*) in sedem metuljev (ruski medvedek *Callimorpha quadripunctaria,* barjanski okarček *Coenonympha oedippus,* hromi volnoritec *Eriogaster catax,* travniški postavnež *Euphydryas aurinia*, Scopolijev zlatook *Lopinga achine,* črni apolon *Parnassius mnemosyne*, petelinček *Zerynthia polyxena).*

Tri od zgoraj naštetih habitatnih tipov, ena rastlinska vrsta in ena vrsta metulja so uvrščeni kot prioritete v Dodatkih I in II Direktive o ohranjanju naravnih bivališč ter prosto živečih živalskih in rastlinskih vrst (the Council Directive 92/43/EEC ("Habitatna direktiva")).

V okviru projekta so bila s pomočjo kartiranja habitatnih tipov evidentirana območja najpomembnejših habitatov, rastišč in prebivališč ogroženih vrst, pripravljene so posebne upravljalske smernice za takšno gospodarjenje, ki podpira ohranitev habitatov in vrst, sklepajo se dogovori z lastniki teh območij za redno vzdrževanje teh območij po posebnih smernicah s finančnim nadomestilom za "privatno" varstvo teh območij, obnovljena sta dva kala (do konca projekta bosta obnovljena še dva), stara šola v Rakitovcu pa je bila preurejena v informacijski center za izletnike in turiste, kjer je postavljena stalna razstava o kraških kalih in biotski pestrosti Kraškega roba.

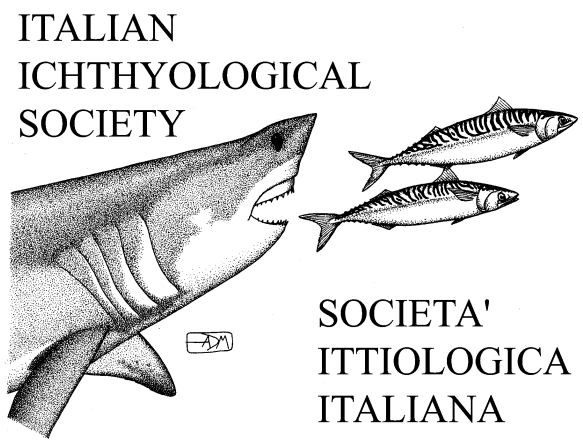
Pomembno vlogo v projektu ima ozaveščanje in izobraževanje lokalnega in širšega prebivalstva o pomenu in naravnih vrednotah Kraškega roba. V ta namen redno izdajajo glasilo Kraški rob, vzpostavljena je bila spletna stran, prirejajo se različne delavnice in predavanja, pripravlja pa se tudi monografija in TV oddaja.

Zaradi nespametnega ravnanja z naravo v preteklosti se je veliko rastlinskih in živalskih vrst znašlo na robu preživetja. Njihova prebivališča so okrnjena in ogrožena, zato številnim vrstam grozi celo izumrtje. Sredstva iz projektov LIFE-Narava so namenjena ohranitvi ter zaščiti takšnih ogroženih vrst in njihovih prebivališč. Projekt sestavljajo številne akcije in ukrepi, katerih glavni cilj je ohraniti naravno in kulturno dediščino Kraškega roba prek vzpostavitve modela trajnostnega razvoja območja. Model temelji na ohranjevanju tradicionalnih kmetijskih praks in promociji sonaravne (pasivne) rekreacije in turizma.

Dolgoročna prihodnost tega območja je odvisna od najvrednejšega potenciala, ki postaja v sodobnem svetu vse vrednejši argument: neokrnjena naravna in kulturna krajina ter trajnostni razvoj območja.

**Andrej Sovinc in Bojana Lipej**

THE ITALIAN ICHTHYOLOGICAL SOCIETY




The Italian Ichthyological Society (Società Ittiologica Italiana) was founded on 18th January, 2004. It is a non-profit scientific organization, seeking to advance the scientific study of fishes (with special emphasis on sharks) as well as to promote education, conservation, and wise utilization of marine resources. The Society will organize courses and exhibitions, hold meetings, present research reports, publish articles and books, lead various research programmes, participate in projects led by other scientific institutions, collect data, fish specimens and publications, and promote collaboration between ichthyologists. The founding members of the Italian Ichthyological Society are: Alessandro De Maddalena (President), Luigi Piscitelli (Vice-President), Vittorio Gabriotti (Adviser), Antonio Celona (Adviser) and Alessandro De Marinis (Adviser). The Society's membership consists of several members paying their annual dues. Readers can visit the official website of the Italian Ichthyological Society for information on the Society's initiatives, courses, lectures, exhibitions, direction, membership, at the address:

http://it.geocities.com/societaittiologicaitaliana

The Italian Ichthyological Society began to implement some interesting projects already during its first months of existence. Firstly, it organized ichthyology courses including specific subjects, such as biology and ecology of the great white shark, *Carcharodon carcharias*, general shark biology, and morphology of fishes of the Mediterranean Sea. Secondly, it took part in the

collection of data on sharks inhabiting the Adriatic Sea for the preparation of the book *"Sharks of the Adriatic Sea"* (Knjižnica Annales Majora, 2004), written by Lovrenc Lipej, Alessandro De Maddalena and Alen Soldo. Recently, the Society also substantially contributed to the organization of the exhibition *"Alla ricerca del grande squalo bianco" ("In search of the great white shark"),* curated by Vittorio Gabriotti and Alessandro De Maddalena. The exhibition was held at Sala Civica dei Disciplini (XVI century) in Castenedolo (Brescia), Italy, from October 21 to October 24, 2004, and attracted few thousand visitors. It featured photographs by Vittorio Gabriotti, illustrations by Alessandro De Maddalena, detailed and updated biological information, shark specimens from the Italian Ichthyological Society (mostly from the Mediterranean area), and jaws of a 5-meter long white shark from the ancient Settala Museum (XVII century). The visitors were able to watch slide shows on white sharks and sea lions and partake in conversations concerning these animals. The exhibition was a huge success and an important initiative for raising awareness of sharks. In the ensuing months, the exhibition will travel around Italy.

The complete address of the Italian Ichthyological Society is:

Società Ittiologica Italiana
Via L. Ariosto 4, I-20145 Milano, Italy
Phone: +39 02 48021454
E-mail: a-demaddalena@tiscali.it
Official web site:
http://it.geocities.com/societaittiologicaitaliana

**Alessandro De Maddalena**

***Three of the Italian Ichthyological Society's founding members while examining shark jaws at the Milan Fish Market. From left to right: Vittorio Gabriotti, Luigi Piscitelli and Alessandro De Maddalena. (Photo: C. Perotti)***
***Trije ustanovni člani Italijanskega ihtiološkega društva si ogledujejo žrelo morskega psa na milanski ribji tržnici. Od leve proti desni: Vittorio Gabriotti, Luigi Piscitelli in Alessandro De Maddalena. (Foto: C. Perotti)***


***Poster of the exhibition "Alla ricerca del grande squalo bianco" ("In search of the great white shark"), which was organized with the participation of the Italian Ichthyological Society and held in Castenedolo, Italy, October 21-24, 2004.***
***Plakat za razstavo "Alla ricerca del grande squalo bianco" ("Na sledi belega morskega volka"), organizirano v sodelovanju z Italijanskim ihtiološkim društvom v Castenedolu med 21. in 24. oktobrom 2004.***

# MEDNARODNI INŠTITUT ZA MORJE (INTERNATIONAL OCEAN INSTITUTE): ZASEDANJI IOI V PIRANU

Med 13. in 16. oktobrom 2004 sta na Morski biološki postaji Nacionalnega inštituta za biologijo v Piranu potekali pomembni zasedanji Mednarodnega inštituta za morje (IOI): sestala sta se Upravni odbor IOI, ki vodi in usmerja delovanje te nevladne organizacije, in Odbor direktorjev operativnih centrov IOI. Slednji – 25 operativnih cetrov (OC IOI) deluje v različnih delih sveta (v severni in južni Ameriki, Afriki, Aziji, Oceaniji in Evropi) – so najpomembnejši izvajalci dejavnosti IOI.

Osnovno poslanstvo IOI (www.ioinst.org) je podpora trajnostnemu razvoju ter ohranjanju svetovnega oceana kot vira življenja in širjenje načel skupne dediščine, kot so svečano zapisana v Konvenciji Združenih narodov o pravu morja. IOI si prizadeva za uveljavitev pojma *Pacem in maribus – mir oceanom* za sonaravno gospodarjenje in ohranjanje oceanov v dobro prihodnjih generacij. IOI je kot nevladno, neprofitno mednarodno organizacijo ustanovila Elisabeth Mann Borgese (1918–2002), ki so jo poimenovali "mati oceanov". Hčeri Nobelovega nagrajenca Thomasa Manna, ki je okusila preganjanje in begunstvo, je bilo življenjsko vodilo "mir in pravičnost za vse". Svoje nazore in ideje je uveljavljala tudi v dolgoletnih pogajanjih in pripravi Konvencije ZN o pravu morja, ki jo danes pojmujemo kot "morsko ustavo", velike zasluge pa ima tudi za ustanovitev Komisije ZN za trajnostni razvoj. Prva konferenca *"Pacem in maribus"*, ki jo je Elisabeth Mann Borgese organizirala na Malti, je tlakovala pot do ustanovitve IOI leta 1972 kot nevladne mednarodne organizacije s sedežem na Malti. Osnovne cilje, kot jih je vizionarsko zasnovala Elisabeth Mann Borgese, IOI na čelu z Upravnim odborom, katerega člani so ugledni strokovnjaki z vsega sveta, prek mreže svojih operativnih centrov uspešno udejanja tudi po ustanoviteljičini smrti.

IOI promovira miroljubno in trajnostno rabo morskega okolja in njegovih virov, osnovne dejavnosti pa so: izobraževanje in došolanje upravljalcev morskega okolja in virov, sodelovanje pri tematskih izobraževalnih programih Združenih narodov in drugih mednarodnih organizacij; raziskave in analize v podporo iniciativam Združenih narodov za miroljubno, trajnostno gospodarjenje z morskimi viri in za varovanje morja ter podpora nacionalnim in regionalnim iniciativam pri razvoju politike in zakonodaje na tem področju. Za dosego teh ciljev IOI organizira odmevne mednarodne konference, predvsem PIM – *Pacem in maribus*, ki je globalni forum za morje – vodstvene seminarje o kritičnih in inovativnih tematikah v zvezi z upravljanjem oceanov; posebno pozornost pa posveča programom podpore in partnerstva pri pripravi in udejanjanju miroljubne politike gospodarjenja z morji ter ozaveščanju javnosti. Slovenija je postala članica te ugledne mednarodne organizacije z ustanovitvijo operativnega centra na Morski biološki postaji Piran leta 2003 (IOI OC Slovenija). Operativni center IOI na Morski biološki postaji je skupaj z Mednarodnim centrom za promocijo podjetij Ljubljana in Znanstveno-raziskovalnim središčem Univerze na Primorskem v Kopru pripravil program dela; kot eno prvih skupnih nalog IOI pa je OC Slovenija sprejel organizacijo zasedanj Upravnega odbora in Odbora direktorjev.

Na zasedanju v Piranu je Odbor direktorjev OC IOI sprejel vrsto priporočil za bodoče delo, prevsem pa usmeritve za usklajeno delovanje globalne mreže operativnih centrov s poudarkom na izobraževanju, šolanju, podporo programom za lokalno obalno prebivalstvo ter ženske in otroke. Te usmeritve je podprl tudi Upravni odbor, ki je poudaril potrebo po novi viziji za prihodnost oceanov v času kriz varnosti, naraščajoče revščine in ogroženega okolja. Med drugim je Upravni odbor obravnaval tudi možno svetovalno oz. mediacijsko vlogo IOI pri reševanju sporov pri delimitaciji morskih mej; s tem v zvezi bo skupina vrhunskih strokovnjakov za pomorsko pravo v letu 2005 pripravila študijo. Upravni odbor IOI je kot prednostno vodilo za pripravo bodočih projektov sprejel politiko tematsko zaokroženih vsebin, ki jih IOI skupaj z mrežo operativnih centrov lahko uresničuje na globalni oz. regionalni ravni. Te teme so: raziskave in zaščita koralnih grebenov, integralno gospodarjenje z obalnimi območji, ravnanje v primerih katastrof, vključno z ocenami tveganj in zaščito pred njimi, ter sodelovanje pri dejavnostih v zvezi z Mednarodnim polarnim letom (2007-2008). Izhodišča za slednje je kot gost na zasedanju predstavil dr. Sarukhanian, svetovalec pri WMO (Svetovni meteorološki organizaciji). Na zasedanju je Upravni odbor potrdil poročilo o pripravah na naslednjo konferenco PIM, ki bo v Avstraliji jeseni 2005 ("Building Bridges towards Integrated Oceans Governance: Linking Ocean Science, Engineering, Technology and Policy"). Naslednja konferenca PIM bo l. 2007 predvidoma na Malti.

***Udeleženci srečanj IOI pred piransko občinsko palačo (Foto: V. Bernetič).***

Veliko pozornosti je Upravni odbor IOI posvetil tudi sodelovanju z Združenimi narodi in drugimi mednarodnimi organizacijami, zato je kot gost na zasedanju sodeloval tudi direktor UN DOALOS/OLA (Združeni narodi, Oddelek za oceane in Konvencijo o pravu morja, Urad za pravne zadeve). Direktor dr. Vladimir Golitsyn je predstavil dejavnosti UN DOALOS in Upravni odbor IOI je sprejel priporočilo o prihodnjem sodelovanju zlasti pri programu DOALOS TRAIN-SEA-COAST. Poleg tega bo ob zasedanju Komisije ZN za trajnostni razvoj IOI v aprilu 2005 pripravil poseben sestanek. Prav tako je Upravni odbor sprejel priporočilo o vključevanju IOI v dejavnosti "Desetletje izobraževanja za trajnostni razvoj (2007–2016)", ki jih načrtujejo Združeni narodi. Zato bo IOI poglobil sodelovanje z UNESCO-m in UNEP-om. Upravni odbor IOI je sprejel tudi priporočila o tesnejšem sodelovanju v okviru programov EuroMed in EuroOcean ter drugih sorodnih dejavnostih, ki jih podpira Evropska unija.

Kot gost zasedanja je udeležence pozdravil minister za promet Republike Slovenije prof. dr. Marko Pavliha tako v vlogi predstavnika vlade kot tudi strokovnjaka za mednarodno morsko pravo. Člani Upravnega odbora in Odbora direktorjev IOI in gostje zasedanja so se tudi udeležili dogodka izpustitve želve v morje. To dejanje – aktivnosti potekajo v okviru programa Sredozemskega akcijskega načrta UNEP v organizaciji regionalnega zavoda za zaščito narave in piranskega akvarija – se simbolično in praktično ujema s poslanstvom in delovanjem IOI v korist življenju v morju kot tudi ciljem sonaravnega gospodarjenja. V imenu gostiteljice – piranske občine – pa je ugledne goste toplo sprejel podžupan g. Žerjal in jim predstavil Piran.

Zasedanji Upravnega odbora in Odbora direktorjev operativnih cetrov IOI so s precejšnjo pozornostjo spremljali tudi slovenski mediji: udeleženci so imeli intervjuje za nacionalno televizijo in osrednji slovenski dnevnik DELO, o zasedanju pa so poročala tudi druga sredstva javnega obveščanja.

Prihodnje zasedanje Upravnega odbora IOI in Odbora direktorjev operativnih centrov bo jeseni 2005 Avstraliji (Townsville) pred konferenco *Pacem in maribus*.

**Alenka Malej**

## IN MEMORIAM

### Obituary
### Juan Antonio Moreno García
### 1952–2004

Juan Antonio Moreno was born in Salamanca, Spain, on 24 May 1952, and he was the middling of three siblings, Concha, the older, and Carlos, the younger. He died on 9 November 2004 in the Hospital of Segovia, Spain, without hardly suffering, when the forces of his already excessively damaged organism definitively abandoned him.

Juan Antonio was always a brilliant student who took all his primary and secondary schooling with scholarships of the State. His extensive and multidisciplinary scientific activity goes back to the beginning of the 1970s, when he was still a student at the Faculty of Biological Sciences of Complutense University of Madrid (UCM). Between 1973 and 1976, he carried out such tasks as the classification and cataloguing of the entomologic collection of the group "Topete" in Madrid, dependent of the National Park of Doñana, he investigated Coleoptera Carabidae in the Chair of Invertebrates Arthropods, and worked on the preparation and assembly of the first skeletons of the Chair of Vertebrates Zoology Museum. In 1976, he graduated in biological sciences, in the UCM. It was then that he began to study Chondrichthyans, carrying out multitude of fieldwork at fish markets, diving and spending much time on board *"marrajeras"* (fishing ships that catch sharks, basically makos, *"marrajos",* with longlines). In 1977, when completing the obligatory military service in Tarifa and Algeciras, he made a superb film on sharks for the Infantry Regiment of *Extremadura 15* of the Spanish Army. Regarding this work, he always remembered his face to face encounter with a great mako while diving. During 1978 and 1982, he alternated his work in the preparation of his postgraduate exams with other activities like collaborating with the Spanish Institute of Oceanography of Santander in biometry topics and fishing aspects of the species captured with trawl and seine gears, or collaborating with Dr. W.E. Reif from the Institute and Museum of Geology and Palaeontology of Tübingen in studies of comparative anatomy of Chondrichthyans both fossils and living. In 1981, he described a new species, *Carcharhinus acarenatus*, which some researchers from the Anglo-Saxon sphere insisted in nominating as synonymy of *Carcharhinus brachyurus*, without not even revising the holotype and the paratypes of the new species deposited in the UCM to check the distinctive diagnostic characters. In 1982, he obtained his doctor's degree on the basis of his shark project: *Revision of the genus* Carcharhinus *of the Northeastern Atlantic and Western Mediterranean*, worthy of the maximum academic qualification. Between 1982 and 1984 he took part in several campaigns to trap micromammals in order to get specimens for the studies and collections of the Chair of Vertebrates and in successive bird ringing campaigns. He was in charge of the classification and updating of the Ichthyological Collection of this Chair, to which he donated his own collection of jaws, skins, heads and fetuses of sharks, and he led four shark projects. In 1983, the Iberian Ichthyological Society was founded. In 1984, when returning from the first General Meeting of the Catalan Ichthyological and Herpetological Society, which was held in Sitges (near Barcelona), a road accident changed his life forever and left him *"beached in dry dike",* as he used to say. All his projects, professional as well as personal (his marriage failed soon after the accident), were left on that fateful motorway. Juan Antonio spent much time in the Tetraplegics Hospital of Toledo, and had to return frequently to it due to the seriousness of his health. He was forced to face a new situation, and it was very hard. He was only 32 years old, and until then his activities had been almost frantic. In spite of a series of setbacks and moments of desperation, however, he continued being as passionate as always in everything he made, and always demonstrated admirable will and tenacity. In 1991 he obtained his doctorate in biology with the thesis: *Lamnidae and Alopiidae (Chondrichthyes, Euselachii) of the Northeastern Atlantic and Western Mediterranean*, mentored by Dr. Francisco Bernis, one of the most noted Spanish biologists. This achievement is one of the most remarkable in Juan Antonio's life, considering that by then he had been anchored to a wheelchair for seven years. During these seven years he collaborated occasionally with Dr. J. Cassey, of the NOAA, in the identification and taxonomy of deep-sea sharks from the Northwestern Atlantic, directed the Group of Ichthyological Investigation of the Chair of Vertebrates (UCM), and supervised different researches on sharks. Regarding his academic activity, Juan Antonio was attributed to the Chair of Zoology of the UCM as investigator during the 1980–1994 period. He was deeply engaged in the subjects of fish migrations, biology of sharks and fishing gears, and in the study of pelagic shark landings in the Atlantic Southern Spanish coast. In 1993 was named Honorary Collaborator of the Chair of Vertebrates from the Faculty of Biological Sciences of the UCM. In spite of this career, Juan Antonio was never a person to please the offices of the Faculty. He always preferred his independence and free action, although his posture was not well understood by some of his colleagues and even pupils, which was very painful for him and traumatized him deeply. His relationship with the University finished quite bitterly, *"after 17 years of autonomous work",* and *"trying to take the practice of teaching with my Aristotelian method of learning",* as stated by him. Autonomous, because he never belonged to the payroll of investigators of the Faculty, something very frequent in the Spanish

***Juan Antonio Moreno with a taxidermied specimen of** Carcharhinus acarenatus**, the shark species he described in 1981. (Photo: J. A. Moreno)***
***Juan Antonio Moreno z nagačenim primerkom** Carcharhinus acarenatus**, morskega psa, ki ga je opisal leta 1981. (Foto: J. A. Moreno)***

University system that prolongs the stay of graduates and doctors in the Centres for years through economically insufficient scholarships, or even without any type of economic assignment. With his departure, the Chair of Vertebrates abandoned the research in Elasmobranchs. This academic rupture, however, gave way to the birth of the Shark Ichthyological Research Group (GIIT), which he founded in 1994.

Another field that highly interested Juan Antonio Moreno was the exploitation of sharks. He gained much experience aboard fishing ships and at fish markets, seeing how hundreds of specimens were wasted daily through the sharks' very scarce utilization (he was strongly opposed to the practice of "finning"). This topic worried him so much that he ended up organizing meetings with Shipowners and Masters from the Fish Guild of Algeciras (one of the fish ports with more shark landings in Spain) in order to analyse the problem of the longlining and to elaborate a plan of improvement in the utilization of the biomass captured by these ships. An aspect in which he was highly interested was the tanning of shark skin for its use in fashion industry. He maintained the formula of the industrial process secretly, and believed firmly that this kind of skin could reach high prices on the market and that "*marrajeros*" (the men who fish sharks) could earn more even if catching fewer specimens.

But Juan Antonio was not only the pioneer shark investigator in Spain and Europe. He was also one of the best ever wildlife illustrators, if not the best, in Spain. His serious limitations, however, did not prevent him to continue with his artistic vocation after the accident. If he was unable to draw with his own hands, the computer would do it for him. He took a course in Design of Graphic Arts by Computer, which eventually allowed him to continue his work in this field. The course proved to be very useful indeed, for now we can enjoy some of the results in his *Guía de los tiburones del Atlántico Nororiental y Mediterráneo* (Guide of sharks of the Northeastern Atlantic and the Mediterranean), published in 1995 by Pirámide Publishing and recently reedited by Omega Publishing – the reedition that took him much strength and that he could not even see printed.

In 1995, Juan Antonio left his habitual residence in Móstoles, near Madrid, to move to Villacastín, a small town near Segovia, for health reasons. There, he remained confined until his death. He had fought a battle, and fortunately he had did not fought it alone. Isabel, his mate during the last 18 years, had always been at his side. A strong and valiant woman that opted for a difficult and tortuous way, that of a complex coexistence with the person who depended completely on her, and to whom we should thank to make his life a little easier. Now Juan Antonio rests, at last, as he wanted, although in our selfishness we will find it difficult to overcome his absence.

The scientific community has lost one of the greatest ichthyologists and shark specialists. His name, however, will live forever in the field of shark research and his publications will remain as references for future works on sharks inhabiting the Mediterranean Sea and the Iberian waters. We will remember him as an honest man, with a deep knowledge of shark biology, and as a person who was always ready to support his colleagues in any interesting project by even providing his own data, the result of his great experience in this field.

Rest in peace, Juan Antonio.

***Juan Antonio Moreno giving a tender kiss to a specimen of** C. acarenatus**. (Photo: J. A. Moreno)***
***Juan Antonio Moreno nežno poljublja primerek** C. acarenatus**. (Foto: J. A. Moreno)***

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***Juan Antonio Moreno with his friends Joan Barrull and Isabel Mate, in his house in Villacastín, where his health problems confined him during the last ten years of his life. (Photo: J. Barrull and I. Mate)***
***Juan Antonio Moreno s svojima prijateljema Joanom Barrullom in Isabel Mate na svojem domu v Villacastínu, h kateremu je bil zaradi hudih zdravstvenih težav priklenjen zadnjih deset let svojega življenja. (Foto: J. Barrull in I. Mate)***

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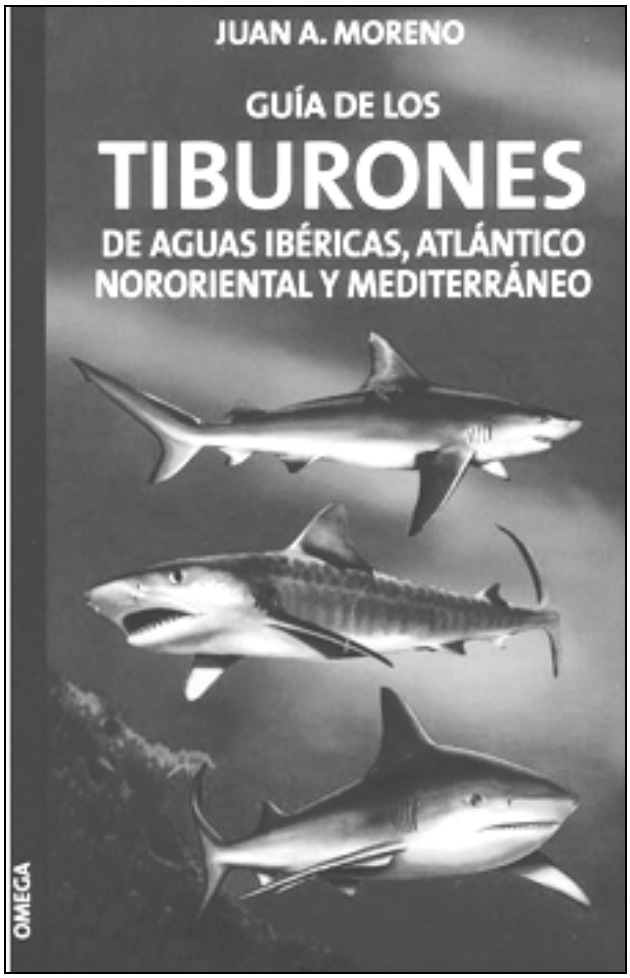


***The excellent, comprehensive and accurately illustrated book on sharks of the Eastern-North Atlantic and the Mediterranean Sea written by Juan Antonio Moreno and recently republished as a revised edition by Omega Publishing, Barcelona.***
***Izvrstna obsežna knjiga Juana Antonia Morena z natančnimi ilustracijami morskih psov vzhodnega Severnega Atlantika, ki jo je pred kratkim revidirala in na novo izdala barcelonska založniška hiša Omega Publishing.***

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- Panorama actual de los tiburones en España.
- Descripción de una nueva especie de tiburón: *Carcharhinus acarenatus*.

**Segundas Jornadas de Ictiología Ibérica, Barcelona, Spain, 1983**
- Contribución al conocimiento de la biología y distribución del *Carcharhinus longimanus* (Poey, 1865).
- Presencia de *Carcharhinus falciformis* (Müller & Henle, 1841) en aguas ibéricas y primer registro en el Mediterráneo.
- Contribución al conocimiento de *Torpedo marmorata* Risso, 1810.
- Morfología y biología de *Carcharhinus acarenatus*. Nueva especie descrita por el autor en 1981.
- Datos de reproducción y natalidad de *Alopias vulpinus* (Bonnaterre, 1788).
- Primer registro de *Carcharhinus amboinensis* (Müller & Henle, 1841) en aguas del Atlántico Nororiental.
- Propuesta de nominación vernácula de las catorce especies del Género *Carcharhinus* del Atlántico Nororiental y Mediterráneo Occidental registradas por el autor.
- Primer registro de *Galeocerdo cuvieri* (Perón & Lesuer, 1882) en aguas ibéricas.
- Aprovechamiento industrial del tiburón.

**VI Bienal de la Real Sociedad de Historia Natural, Santiago de Compostela, Spain, 1983**
- Morfología y biología del Jaquetón Lobo *Carcharhinus obscurus* (LeSueur, 1818).
- Distribución, biología y breve diagnosis de *Alopias superciliosus* (Lowe, 1840).

**I Reunió General Societat Catalana d'Ictiologia i Herpetologia, Sitges, Spain, 1984**
- Los Jaquetones *(Carcharhinus)* del Mediterráneo Occidental y del Atlántico Ibérico-Marroquí.
- Importancia de las pesquerías de tiburón en el Sur de España.
- Nuevos registros de *Isurus paucus* Guitart Manday, 1966.
- Posibilidades del aprovechamiento industrial del tiburón.

- Notas sobre la captura de *Ophichtis rufus* (Rafinesque, 1810).

**Simposium Internacional sobre Diversidad Biológica (Departamento Interuniversitario de Ecología de Madrid and ADENA), Madrid, Spain, 1989**
- Importancia de los tiburones en la ecología marina.

**I Congreso Internacional de las Asociaciones Sudoccidental-Europeas de Parasitología, Valencia, Spain, 1991**
- Sobre la presencia de *Dinemoura producta* Müller, 1785 (Crustacea Copepoda: Pandaridae) en *Isurus oxyrinchus* (Chondrichthyes: Lamnidae) en aguas del Mar Mediterráneo.
- *Pandarus* sp. Leach, 1816 (Crustacea Copepoda: Pandaridae) ectoparásito de *Prionace glauca* (Chondrichthyes: Carcharhinidae) en aguas del Mediterráneo suroccidental.

**International Scientific Conference "Sharks Down Under", Sidney, Australia, 1991**
- Comparative Study of the genus *Isurus* (Rafinesque, 1810) with notes about its biology. Descriptive variations of Azores endemism: "Criollo Mako" *(Isurus* sp.).
- Discussion about the reproductive and size biology: phenology and fisheries of common thresher shark: *Alopias vulpinus* (Bonnaterre, 1788) in the North Atlantic and Occidental Mediterranean.
- Reproductive biology, weight and sizes, and fishing phenology of the bigeye thresher shark: *Alopias superciliosus* (Lowe, 1839) in the Northoriental Atlantic Ocean and the Occidental Mediterranean.

**VIII Congress Societas Europaea Ichthyologorum, Oviedo, Spain, 1994**
- Discussion about the validity of *Carcharhinus acarenatus* Moreno J. A. & Hoyos A., 1983 as a nominal species, and notes about its distribution, general biology and distinctive taxonomic features.
- Livery variations in the Chondrichthyes, Euselachii, from the NE Atlantic Ocean and Mediterranean Sea, and discussion about validity as taxonomic features in Systematic.
- Reproductive Biology of the Family Alopiidae: particular anatomical formations, foetal development, ovophagy, sizes biology, and reproductive ecology.
- Feeding biology and differential predatory success of *Sphyrna zygaena* (Linnaeus, 1758) from the North-Eastern Atlantic Ocean.
- Occurrence, abundance and seasonality of the Family Sphyrnidae in the North-Eastern Atlantic Ocean and the Western Mediterranean Sea.

**Joan Barrull, Isabel Mate**
**and Alessandro De Maddalena**